

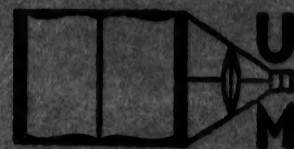
Vol. XIX

No. 3

# DISSERTATION ABSTRACTS

*ABSTRACTS OF DISSERTATIONS AND  
MONOGRAPHS IN MICROFORM*

UNIVERSITY MICROFILMS, INC.  
ANN ARBOR, MICHIGAN: 1958



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## AGRICULTURE

### AGRICULTURE, GENERAL

#### DEVELOPMENT OF VOCATIONAL AGRICULTURAL EDUCATION IN TEXAS, 1917-1957

(L. C. Card No. Mic 58-2844)

Julian Clarence Green, Ph.D.  
Louisiana State University, 1958

Supervisor: Professor J. C. Floyd

This study traces the development of vocational agricultural education in Texas from its beginning in 1917, through the school year 1956-57. Each phase of the program, conducted on a state level, is traced through its stages of development independently. The study deals specifically with the following phases of the program: the all-day program, state FFA association, adult and young farmer educational programs, programs for training teachers of vocational agriculture, administration and supervision of the program, history of the Vocational Agriculture Teachers' Association of Texas, and biographies of the early leaders of the state's program of vocational agriculture.

To accomplish such an undertaking, it was necessary to locate and carefully examine records and publications located in various parts of the state, and, in several instances, outside the state. Many individuals were interviewed for the purpose of clarifying the data in existing records. The data was carefully analysed for important content, and the functional portions were organized and assembled to form the study.

The teaching of agriculture was introduced in the secondary schools of Texas in 1903, and the teaching of elementary agriculture was required by law after 1907. The departments of vocational agriculture have increased from twenty-eight white departments in 1917 to 907 departments in 1956-57. The program, as it grew and expanded, incorporated many new ideas and practices; namely, a state judging contest, systematic procedures for developing the local long-time program and annual teaching plans, expanding the curriculum to include farm mechanics, district supervision of the program, formation of a state FFA association, organizing educational programs for adult and young farmers, conducting annual conferences for teachers of vocational agriculture, and providing specialists to assist teachers with problems in technical agriculture. Those ideas and practices of their basic principles, which were introduced before 1930, form the major portions of the present day program.

Supervision, as provided at the present time, is delegated to ten area supervisors. Each supervisor is responsible for ninety or more departments of vocational agriculture. Area supervisors, thus burdened with a large number of departments, must provide assistance to groups of teachers rather than individuals. Local supervision

would be greatly increased by transferring those functions to local administrators.

Since 1935, the Texas program of vocational agriculture has been promoted, almost exclusively, through the state FFA association. The FFA movement in Texas was greatly accelerated through a monthly publication, state FFA conventions, contests, and degree advancements.

Another association, The Young Farmers of Texas, was organized in 1953, and twenty-two local and county chapters had affiliated with the state association by June 30, 1957. There are many indications that the association will play a decided role in the future in stimulating the young farmer education program in Texas.

White teachers of vocational agriculture are trained at seven colleges of the state. It has been a practice of the State Board for Vocational Education to approve additional teacher training institutions as the number of departments of vocational agriculture increased within the state.

The policies of the State Board for Vocational Education, pertaining to vocational agriculture, are administered by an Assistant Commissioner of Education and the personnel in the State Department of Agricultural Education.

A state association of the teachers of vocational agriculture was organized in 1940-41. The association enjoys almost unanimous support from the teachers of vocational agriculture, even though the annual dues are one half of one per cent of a teacher's salary. The association has dedicated its efforts toward improving vocational agriculture and the Texas Association of the Future Farmers of America. Microfilm \$6.30; Xerox \$22.20. 495 pages.

#### CONTROL OF THE EUROPEAN CORN BORER WITH THE FUNGUS, BEAUVERIA BASSIANA AND THE BACTERIUM BACILLUS THURINGIENSIS

(L. C. Card No. Mic 58-3025)

George Theron York, Ph.D.  
Iowa State College, 1958

Supervisor: Tom A. Brindley

Beauveria bassiana was obtained from corn borers which succumbed to the disease from natural infection. Bacillus thuringiensis was received from Dr. C. G. Thompson of the insect pathology laboratory of the U.S.D.A. Both organisms were cultured on commercial feed bran to obtain quantities sufficient for field trials.

The writer experienced a marked debilitation from exposure to high concentrations of Beauveria spores.

Field tests were conducted at Ankeny, Iowa. Beauveria was applied to corn plants in water sprays, in flour, and on granular carriers. Applications of Bacillus were all on granular carriers.

In 1955 the average reduction of first brood larvae in four tests using sterilized corn meal as a carrier for *Beauveria* spores was 88 percent, while attapulgate granules in the same tests gave 78 percent reduction. Maximum reduction of the second brood population was 42 percent.

In first brood timing experiments in 1956 the highest mortality of 90 percent was obtained on the last date of application of June 29. Two experiments using the high-clearance machine for applications of one part *Beauveria* spores to 500 parts attapulgate granules at 20 pounds per acre did not give satisfactory control. Second brood experiments also failed to give satisfactory control.

In the 1957 timing experiment with *Beauveria* for the first brood, best results were obtained on June 25, with nearly equal results on June 20 and June 30. In an experiment on 12 and 20 pound rates per acre using 3 grams of spores per pound, there was no appreciable difference in control. The reduction was from 60 to 70 percent.

Best results in the second brood timing experiment were obtained from the first and second applications. Although the reductions were in the 50 to 60 percent range they were comparable to insecticides.

Formulations of 2, 10, and 50 grams of *Bacillus* per pound of corn meal gave 46, 63, and 85 per cent reduction of the first brood. Two applications of 20 pounds corn meal per acre with 50 grams of *Bacillus* per pound gave 77 percent control of the second brood.

Microfilm \$2.00; Xerox \$4.60. 87 pages.

## AGRICULTURE, ANIMAL CULTURE

### A STUDY OF THE INFLUENCE OF CERTAIN DIETARY CONSTITUENTS ON THE OCCURRENCE AND HISTOCHEMICAL CHANGES IN MUSCULAR DYSTROPHY

(L. C. Card No. Mic 58-3035)

Ollie Monroe Bowman, Ph.D.  
State College of Washington, 1958

Six separate experiments were conducted involving a total of 56 rabbits, 40 calves and 100 pregnant ewes.

The first rabbit experiment was designed to study the comparative anti-dystrophic effects of different levels of alpha-tocopherol, Visnol and DPPD. It was found that 15 milligrams of alpha-tocopherol per rabbit per day and one-tenth per cent DPPD on a dry weight basis protected the animals from muscular dystrophy. Visnol did not afford protection.

The second rabbit experiment was designed to determine the protective level of Visnol and to determine if there were any histological differences between muscular dystrophy produced by a vitamin E, potassium, choline or a combined potassium and choline deficiency. The protective level of Visnol was found to be between 0.1 per cent and 0.5 per cent of the dry matter intake. An uncomplicated vitamin E deficiency was expressed microscopically as a hyaline degeneration of the skeletal and cardiac muscles, sometimes accompanied by calcification. A potassium deficiency was characterized by areas of calcifi-

cation, atrophy and fragmentation of the skeletal muscles. A choline deficiency was manifest by severe calcification, atrophy and hyalinization of the skeletal muscles and degeneration of the cardiac muscles. A combined potassium and choline deficiency was expressed by massive necrosis and calcification of the myocardium, degeneration and demyelination of the sciatic nerve and Zenker's degeneration of the skeletal muscles.

The objectives of the third rabbit experiment were to study further the effects of either a vitamin E, potassium or choline deficiency and the feeding of an analogue of choline; and to determine if blood creatine levels were a reliable indicator of muscular dystrophy. The feeding of triethyl choline caused a severe calcification, atrophy and compensatory hypertrophy and loss of cross striations in many fibers, reduplication of some nuclei and small areas of hyalinization. There was one case of nerve degeneration. Highly significant correlation coefficients were found for the regression of blood creatine levels on time in all lots.

The first calf experiment was designed to determine if DPPD and Vianol would protect calves from vitamin E deficiency symptoms, and to determine if blood creatine could be used as an indicator of muscular dystrophy. The protective level of DPPD was found to lie between 0.1 per cent and 0.5 per cent of the dry matter intake and for Vianol it was found to be between 0.1 and one per cent. Statistical analysis of the blood creatine levels shows a highly significant difference between the treatments, and between the time intervals of blood collection. There was a significant difference between the treatments and the blood levels of creatine.

The objectives of the second calf experiment were to determine if a potassium deficiency and triethyl choline would cause muscular dystrophy; to determine if blood creatine levels were a good indicator of muscular dystrophy; and to determine if there were any degeneration of the sciatic nerve. It was found that a potassium deficiency caused a necrosis of the Purkinje cells, hyalinization and pycnosis of the cardiac musculature, without degeneration of the skeletal muscles. There were several areas of reduplication of skeletal muscle nuclei, but no cardiac or nerve abnormalities in the calves that received the choline analogue.

The objectives of the sheep experiment were to study: (1) the efficacy of BHT in preventing stiff-lamb disease in offspring from ewes fed this antioxidant during pregnancy and (2) the activity of serum glutamic-oxaloacetic transaminase (SGO-T) during the course of development of muscular dystrophy. No cases of muscular dystrophy were developed. The normal level of SGO-T activity at 30 days of age was found to be  $58.42 \pm 5.05$  units per milliliter of serum.

Microfilm \$2.00; Xerox \$4.40. 82 pages.

# THE EFFECT OF CHLORTETRACYCLINE ON NUTRIENT UTILIZATION BY DAIRY CALVES

(L. C. Card No. Mic 58-2988)

Linville John Bush, Ph.D.  
Iowa State College, 1958

Supervisor: N. L. Jacobson

Sixteen male dairy calves (12 Holsteins, two Brown Swiss, two Ayrshires) were used to study the effect of chlortetracycline, fed at a level of 80 mg. per day, on growth and nutrient utilization. The effect of the antibiotic on the digestibility of protein, cellulose and dry matter and on the retention of ash and nitrogen was determined by means of conventional digestion trials conducted during the 5th, 8th and 11th weeks of the experiment. At the beginning of the 12th week, 5 mc. of  $\text{Ca}^{45}$  was administered orally to each calf for the purpose of studying calcium utilization and of obtaining a measure of bone growth during a specified period of the calf's life. Upon sacrifice of the animals at the end of 16 weeks certain bones were removed for chemical analysis and for use in preparing radioautographs.

The average weight gain during the entire experiment (16 weeks) was 164.1 lb. for the chlortetracycline-fed calves as compared to 145.4 lb. for the control calves; however, very little difference in gains was observed between the two groups during the 5- to 11-week period. Measurement of the amount of bone growth during the last 5 weeks of the experiment, by means of the radioautographs, showed very clearly that the increased weight gains of the antibiotic-fed calves over that of the controls were paralleled by greater skeletal development.

No evidence was obtained from the three digestion trials to indicate that chlortetracycline feeding has any effect on ash or nitrogen retention or upon the apparent digestibility of protein, cellulose or dry matter by young dairy calves.

Neither the study on the disposition of radioactive calcium ( $\text{Ca}^{45}$ ) nor the total calcium balance trial gave any substantial evidence to indicate that chlortetracycline feeding has any effect on calcium utilization by the calf.

Only slight differences were found between the two groups of calves with respect to blood levels of reducing sugar and nonprotein nitrogen during the 5th, 8th and 11th weeks of the experiment.

Chlortetracycline feeding was not found to have any effect on the weights of the heart, liver, spleen, kidneys or thyroid gland at 16 weeks of age, when the weight of these organs was expressed as a percentage of body weight.

Microfilm \$2.00; Xerox \$6.40. 135 pages.

# THE IDENTIFICATION AND SOURCES OF THE PROGESTATIONAL HORMONES OF THE BOVINE

(L. C. Card No. Mic 58-3041)

John Gorski, Ph.D.  
State College of Washington, 1958

Progesterone and  $\Delta^4$ -pregnene-20 $\beta$ -ol-3-one were identified in extracts of whole ovaries from non-pregnant

cows. Identification was by paper chromatography, formation of derivatives, and ultraviolet absorption spectra in methanol and sulfuric acid. Concentrations per gram of ovarian tissue were 4.33  $\mu\text{g}$ . progesterone and 0.79  $\mu\text{g}$ . of  $\Delta^4$ -pregnene-20 $\beta$ -ol-3-one.

A small amount of another compound that had a chromatographic mobility similar to androstenedione or  $\Delta^4$ -pregnene-20 $\alpha$ -ol-3-one was detected but identification was inconclusive. The method gave recoveries of 59 per cent of 10  $\mu\text{g}$ . and 50  $\mu\text{g}$ . of progesterone added to 10 gm. of placental tissue, with 10  $\mu\text{g}$ . being the minimum quantity which allowed detection.

The ovaries, adrenals, uterine venous blood, placenta, fetal blood, fetal adrenals, and fetal testis from a cow 258 days pregnant were investigated as possible progestin sources. Approximately 50  $\mu\text{g}$ . of progesterone and 5  $\mu\text{g}$ . of  $\Delta^4$ -pregnene-20 $\beta$ -ol-3-one were measured in the ovaries. Less than 10  $\mu\text{g}$ . of progesterone were detected in the adrenals and all other tissues were negative within the limits of the method. Six other samples of placentae were examined, all with negative results.

Ovaries from cows in the secretory stage of the estrous cycle, early pregnancy, and late pregnancy showed little change in progestin concentration during the three stages. Slightly lower concentrations were noted in late pregnancy.

The corpora lutea contained 90 per cent of the progestins, with the remainder being present in the ovarian stroma after corpora lutea removal. No progestin was detected in the ovaries that had not contained corpora lutea.

Microfilm \$2.00; Xerox \$3.60. 65 pages.

# ANESTHESIA TIME AS A MEASURE OF BODY FAT IN GENETICALLY DIFFERENT GROUPS OF LAMBS

(L. C. Card No. Mic 58-3053)

Frank Alden Hudson, Ph.D.  
Oregon State College, 1958

Major Professor: Ralph Bogart

Three representative groups of twelve lambs of Suffolk, Dorset X Columbia, and Cheviot X Columbia breeding were anesthetized at the weights of 40, 55, and 70 pounds. The twelve lambs comprising each breeding group included six males and six females, of which three were from single births and three from twin births. Information was collected on the length of anesthesia prior to first movement, and the time required for the lamb to stand on its feet after onset of anesthesia. Carcass data including grade, live animal condition score, and carcass fat content were obtained in addition to that for age and daily gain of the lambs at time of the three anesthetic trials.

The purpose of the study was to investigate the duration of action of Kemithal in lambs, and to relate the duration of action to the amount of body fat, with the objective of integrating this procedure into methods applicable to the selection of lambs for early fattening ability.

Suffolk lambs were younger at 40 and 55 pounds, and reached the 70 pound limit 18 days earlier on the average than the crossbred lambs. Suffolk male lambs consistently reached the three test weights at younger ages

than did the females. As the age interval increased in reaching a constant weight, there was a proportionate decrease in daily gain.

When measured from induction of anesthesia, the time required for the lamb to make its first movement, and the time required for it to stand on its feet show a correlation of 0.85. No relationship was found to exist between either of the two anesthesia intervals and per cent of body fat, carcass grade, daily gain, age, or live-animal condition score.

Extreme variation in response to the anesthetic by individual lambs contributed to the lack of relationship between anesthesia time and the other factors studied. Further complications were introduced through the occurrence of respiratory failure at time of anesthesia.

The apparent immunity of the Cheviot X Columbia lambs to respiratory arrest following administration of the anesthetic was noted. On the other hand Dorset X Columbia and Suffolk lambs tended to have increased anesthesia intervals at subsequent administrations of Kemithal.

Correlations between body fat content and the two anesthesia intervals of the Cheviot crossbred lambs were of higher magnitude which may be associated with the absence of the influences of respiratory arrest.

On the basis of the reaction of the Cheviot crossbred lambs, it is felt that further work in studying the relationship between body fat content and anesthesia times is justified. It is proposed that injections of Kemithal be made on a constant age basis, at the lower dosage rate of 0.15 ml. of 10 per cent Kemithal solution per pound of body weight.

Live-animal condition scores and carcass grades have been shown to be unreliable in the estimation of body fat content of lambs. Since these accepted methods are inadequate in detecting lambs that are genetically capable of early fat deposition, it is imperative that these methods be improved, and new techniques, such as the use of anesthetic-body fat relationship, be investigated further.

Microfilm \$2.00; Xerox \$4.00. 75 pages.

#### SEMEN METABOLISM AS INFLUENCED BY SPERM AND SEMINAL PLASMA VARIATIONS IN THE BOVINE

(L. C. Card No. Mic 58-3044)

Nathu S. Kushwaha, Ph.D.  
State College of Washington, 1958

The purpose of this study was to investigate the effects of sperm and seminal plasma variations on the metabolism of semen from dairy bulls.

The problem was approached through two different experiments. Experiment 1 was designed to study the effects of naturally occurring variations, while Experiment 2 was an *in vitro* study in which variations were artificially created.

Experiment 1 incorporated the following four trials:

1. Comparison of first and second ejaculates from young bulls (two Holstein and two Jersey) collected once a week for one year.
2. Comparison of first and second ejaculates from more mature bulls (one Holstein, one Jersey, and one Guernsey) collected once a week for one year.

3. Comparison of eight multiple ejaculates collected on one day at weekly intervals for three weeks from one mature Holstein bull.

4. Comparison of pre- and post-unilateral vasectomy ejaculates collected as two successive ejaculates in one day at twice a week interval for four weeks during each period with four week's rest in between.

Experiment 2 involved plasma alterations of each semen sample from three mature bulls (one Holstein, one Jersey, and one Guernsey) collected once a week for eight weeks.

The results obtained in this study were as follows:

The second ejaculates in both young and more mature bulls showed significantly higher semen volume, lower sperm concentration, lower initial motility, longer resazurin reduction time, higher initial fructose (only in more mature bulls), lower fructose utilization (mg/ml semen) and lower initial lactic acid (only in more mature bulls).

In young bulls, the semen quality improved (judged by various physical and metabolic characteristics of semen) as they reached more complete sexual maturity.

A depletion of semen volume and sperm concentration was noticed due to multiple ejaculation with no appreciable change in initial fructose or initial lactic acid (mg/ml semen). Fructose utilization and lactic acid accumulation (mg/ml semen) were significantly different, but these variations were primarily due to individual ejaculates rather than due to multiple ejaculation.

The post-vasectomy ejaculates showed significantly lower sperm concentration, longer resazurin reduction time, higher initial fructose and higher initial lactic acid (mg/ml semen), and lower fructose utilization (mg/ml semen). The differences in these various physical and metabolic characteristics of semen between first and second ejaculates of post-vasectomy were of considerably lower magnitude as compared with the differences between first and second ejaculates of pre-vasectomy.

The results from altering sperm-plasma ratio indicated an underestimate of metabolic activity during one-half hour incubation for samples having high sperm concentration.

The conclusion was drawn from this study that metabolic measures based on mg/1 x 10<sup>9</sup> sperm were not too variable between any two comparisons under study, in spite of significant variations in these measures based on mg/ml semen. Microfilm \$2.00; Xerox \$3.80. 68 pages.

#### PROGESTERONE CONTENT OF BOVINE REPRODUCTIVE ORGANS DURING PREGNANCY

(L. C. Card No. Mic 58-3013)

Jerry Max Rakes, Ph.D.  
Iowa State College, 1958

Supervisor: R. M. Melampy

A chemical method for the assay of progesterone was developed to quantitatively determine the amount of progesterone in bovine corpus luteum, residual ovarian tissue, placenta, adranal, allantoic and amniotic fluids and blood during different stages of pregnancy. This method

utilized the techniques of partition between organic solvents and paper chromatography. Pooled extracts were further purified by the use of counter-current distribution for infra-red analysis.

Partial identification of progesterone was obtained by the RF value on the chromatogram and absorption maxima. A positive Zimmerman reaction indicated the presence of an alpha, beta-unsaturation in extracts from all tissues and fluids, which would correspond to the delta-4, 3-keto group of progesterone. Infra-red analysis of pooled extracts from corpora lutea, residual ovarian tissue, placental tissue, and blood purified by counter-current distribution, indicated the presence of a carbon-20 carbonyl and a delta-4, 3-keto group.

Data were obtained on weight changes in the bovine uterus and its contents during pregnancy of the cow. Samples of bovine reproductive organs and fluids were collected and assayed by the chemical method developed during this investigation. The data obtained on progesterone concentration and content were grouped into 7 stages of 40 days each. The average progesterone concentration (mcg. per gm.) in the organs and fluids over the entire pregnancy period were found to be 3.4 for corpus luteum, 1.6 for residual ovarian tissue, 0.06 for placenta, 1.5 for left adrenal gland, 0.06 for allantoic fluid, and 0.03 for amniotic fluid. The hormone concentration was highest in luteal tissue with concentration in residual ovarian tissue being next. The average progesterone concentration in peripheral blood collected from Holstein cows during different stages of pregnancy was 0.02 mcg. per ml. whole blood. There was an increase in progesterone concentration as pregnancy progressed with indication that the blood progesterone may drop a few days before parturition.

The average progesterone content (mcg.) in the reproductive organs and fluids over the entire pregnancy period of the cow was found to be 15 in corpus luteum, 12 in residual ovarian tissue, 143 in placenta, 15 in adrenal, 202 in allantoic fluid, and 113 in amniotic fluid. The difference in progesterone content of reproductive organs and fluids of the different breeds of apparent dams used was not significant. Much of the variation was due to the individuality of each dam.

Microfilm \$2.00; Xerox \$5.20. 104 pages.

## AGRICULTURE, FORESTRY AND WILDLIFE

### SOME EFFECTS OF INITIAL STOCKING ON FINANCIAL YIELD FROM EVEN-AGED DOUGLAS-FIR STANDS

(L. C. Card No. Mic 58-3665)

Rudolf Ferdinand Grah, Ph.D.  
University of Michigan, 1958

The purpose of this study is to measure the effects of initial stocking on financial return from even-aged stands of Douglas-fir. The study is approached through the establishment of four hypothetical models of natural stands with each representing a discrete level of initial stocking ranging from twenty-five to one hundred percent of yield table

values. Initial stocking is judged on the basis of number of uniformly distributed crop trees per acre at age twenty. The models are projected through time to age one hundred using Briegleb's approach toward normality equations.

At the end of each ten-year period between ages of twenty and one hundred, volume and quality characteristics of the models are summarized. Quality characteristics are determined by applying standard log grading criteria to the volumes in each model. The grading criteria used are: (1) diameter characteristics of the logs, (2) growth rate in terms of ring width, and (3) knot characteristics. Pruning and fill-in planting were applied as stand improvement measures to assess the physical and economic effect of these inputs on the stands. Values were placed on the volumes in each log grade category using current log market prices.

Economic analysis of the effects of initial stocking was undertaken by the calculation of soil expectation values for each of the models at the end of each ten year period. Comparison between models was made using maximum soil expectation values.

Results are categorized according to physical and economic effects. From a physical viewpoint, the range of initial stocking considered did not significantly affect net volume production at usual harvest ages. Initially understocked stands produced essentially the same volumes as the fully-stocked stands. From the viewpoint of quality output, however, substantial difference between stocking levels is apparent. Stands of low initial stocking produced a larger amount of low quality material. Most of the differential was due to larger knots and excessive amounts of fast-grown wood in the understocked stands. The effect of pruning in the up-grading of logs was greatest in the fully-stocked stands while up-grading in understocked stands was limited by the large amount of excessively fast-grown material.

In the economic analysis, the maximum reduction in soil expectation value due to low initial stocking was \$44. Pruning proved to be economically effective in overcoming value deficiencies in the stands of low initial stocking. However, pruning was most profitable on the fully-stocked stands on the best sites. Planting was profitable only on the stands of very low initial stocking, but in conjunction with pruning, fill-in planting is profitable over a broader range of initial stocking levels.

Three general conclusions are drawn. (1) Low initial stocking reduces financial value of Douglas-fir stands. (2) Fill-in planting and pruning to overcome quality deficiencies are effective and profitable inputs. (3) Stand improvement inputs are most profitable on the better sites, and these sites should have priority in the allocation of funds. Microfilm \$3.10; Xerox \$10.60. 239 pages.

### THE ECOLOGY OF THE TABANIDAE (DIPTERA) OF THE OTTAWA NATIONAL FOREST, MICHIGAN

(L. C. Card No. Mic 58-3671)

Kirby Lee Hays, Ph.D.  
University of Michigan, 1958

The Tabanidae (horseflies and deerflies) are one of the most important families of North American Diptera that

are of medical importance. Some are proven vectors of disease agents and most may be regarded as potential vectors. Due to a long and complicated life history, little had been hitherto known about the ecology and bionomics of these flies. Therefore, an ecological survey as complete as time and facilities permitted was made of tabanids in the Ottawa National Forest, the locale of a recent epizootic of tularemia among beavers.

Thirty-six species of Tabanidae were found. Of these, only eight species were in sufficient numbers that they might be expected to contribute materially to disease epidemics. The total observed flight period of these species was about eighty-five days, from early June until mid-August. The greatest number was found in sub-climax forest types, the principal habitats of beavers and associated mammals. The preference for forest type is only apparent, since it is necessary for the larvae to live in specific aquatic or semiaquatic situations that are generally associated with certain forest types. Thus the correlation with a forest type is an indirect one.

The females of most of these species were observed to suck blood. A high population of warm-blooded animals such as deer, other mammals, and birds almost always provides them with an adequate food supply. Food cannot ordinarily be considered a limiting factor of prime consequence.

The threshold of activity for the adult Tabanidae, living in the Ottawa National Forest, is about sixty-five degrees Fahrenheit. Activity above ninety degrees was negligible. The highest humidity at which activity was observed was eighty-five per cent; the lowest was twenty-eight per cent.

The egg masses observed in the area averaged 371 eggs for *Hybomitra* and 217 eggs for *Chrysops*. No egg masses of *Tabanus* were observed. The eggs were laid on vegetation or other objects, in water or wet places. Eighty per cent were laid within one meter and ninety-four per cent within five meters of water. Sixty-one per cent of all eggs were parasitized by *Telenomus* sp.

Larvae were collected from the margins of all major, permanent aquatic types that could be found and in addition, from several types of temporary pools and other lands which remained moist throughout the year. Twenty-one species were reared from these field-collected larvae. An ecological classification was devised to designate the larval microtypes.

The larvae were, at all seasons of the year, found within the top ten centimeters of soil. When taken from frozen turf they were able to move at any temperature above one degree centigrade. A period of diapause seems necessary in order to assure emergence the following spring. In dry seasons during the summer, the larvae aestivate. When active, they feed upon almost any invertebrates found in the substratum. The Tipulidae provided one of the primary sources of food for the larvae.

Cannibalism plays the major role in the natural regulation of larval numbers. Whenever two tabanids meet one perishes. However, birds, mammals, and insects play an important role. Also the parasite *Phorostoma tabanivora* (Hall) parasitized fourteen per cent of those larvae living in bogs.

Most tabanids pupate near the larval microhabitat but in a drier location. One species moved three to four meters from the water's edge to pupate, but most moved only thirty centimeters before pupation in a drier location.

The geographical range of each species occurring in the

area studied was plotted on a map of North America. This showed five zoographical groups in Michigan. These apparently entered the state from different directions following glaciation; one from Alaska, one from the New England states, one from the Gulf Coast via the Atlantic Seaboard and Pennsylvania, one from the South, east of the hundredth meridian, and one from the South across the United States.

Microfilm \$2.30; Xerox \$8.00. 174 pages.

## AGRICULTURE, PLANT CULTURE

### A PHENOLOGICAL STUDY OF SOYBEANS IN IOWA AND ONTARIO, CANADA

(L. C. Card No. Mic 58-2987)

Donald Murray Brown, Ph.D.  
Iowa State College, 1958

Supervisors: Robert Shaw and Charles Weber

The period required to mature soybeans and other full-season crops has been defined by number of days. However, days in the phenological periods of such crops vary from one year and location to another because environmental factors, especially temperature, moisture and length of day, affect rate of development. This investigation was undertaken to formulate a heat index to describe soybean development more precisely than by days. Certain phenological events and agronomic characters were observed on varieties grown in varying climatic conditions in Iowa and Ontario, Canada.

The periods between phenological events were considered separately and together to compare heat sums with days in the respective periods. In the preflowering period, a heat index that accumulated degrees above a base temperature of 40°F. was less variable than days and just as constant as indices containing factors for day-length and sunshine, because data were collected in a narrow range of latitude and cloudiness. The length of the growth-flowering-pod initiation period was influenced by rainfall distribution as well as temperature and caused heat sums to be nearly as variable as days. High temperatures required reduced weighting in the final period to provide heat sums that were more precise than days in estimating rate of development. Further, combinations of these periods illustrated the effectiveness of reduced weighting of high temperatures to decrease the variability of heat sums in the whole development period. Thus a heat index that accumulated weighted degrees above a base temperature was a more precise measure of the length of developmental periods than number of days and might be used to predict the odds of soybean varieties maturing in different areas.

Observations on certain agronomic characters illustrated the effect of temperature and rainfall on growth and formation of reproductive organs, e.g. pods and seeds, and their resultant effect on seed yields. Growth and pod set were markedly influenced by temperature and rainfall during the growth-flowering-pod initiation period. The size of plant and pod set at maximum podding, as well as environmental conditions during seed development, affected seed

set, seed weight and seed yields. However, seed yields were affected most by environmental conditions during the growth-flowering-pod initiation period.

Microfilm \$2.00; Xerox \$4.80. 94 pages.

# MOISTURE EQUILIBRIA IN SEEDS

(L. C. Card No. Mic 58-2990)

Torcom Chorbajian, Ph.D.  
Iowa State College, 1958

Supervisor: W. E. Loomis

Moisture equilibrium in seeds is a matter of considerable practical importance because of its direct relationship to storage and drying problems. It is also of theoretical interest because of the mechanisms and forces involved. The problem has been studied from the aspects of drying and moisture sorption.

It was found that the drying of soybeans could be described by Fick's law for non-steady state diffusion out of spheres in the moisture range from 40% to 15%, dry weight basis. Fick's law may be written in the differential form for spherically symmetrical diffusion as

$$\frac{\partial m}{\partial t} = D \left[ \frac{\partial^2 m}{\partial x^2} + \frac{2}{x} \frac{\partial m}{\partial x} \right]$$

where  $m$  is the moisture content, expressed as a percentage,  $t$  is the drying time,  $x$  is the space coordinate, and  $D$  is the diffusion coefficient. An empirical equation was found which gave satisfactory agreement with the data below 15%, but, because of its empirical nature, is of no particular value in elucidating the mechanism of moisture movement.

An equation was derived on theoretical considerations, using free energy as the potential function. This may be written for one dimension as

$$\frac{\partial m}{\partial t} = D_F \frac{\partial^2 \Delta F}{\partial x^2}$$

When  $\partial^2 \Delta F / \partial x^2$  was expressed in terms of the moisture content, the resulting equation was found to be a non-linear differential equation, and hence, not amenable to a general solution by addition of particular solutions.

Adsorption and desorption isotherms were obtained at 20° and 30°C for varying conditions. The Brunauer, Emmett and Teller isotherm equation was applied to the desorption isotherms. The equation and the data showed close agreement, with the exception of those values in the very low relative vapor pressure range.

The thermodynamic functions of free energy, enthalpy, and entropy were calculated. The heat of desorption data showed very large values in the lower moisture content range, indicating the great affinity of the moisture to the drier seed. The heat of desorption curve showed further a uniform decrease of affinity with increasing moisture content, suggesting the presence of not one but numerous types and degrees of binding. The heat of desorption becomes negligible in comparison with the heat of vaporization of water at moisture contents above 15%. This probably explains why Fick's law is applicable above 15%, and not below.

Microfilm \$2.00; Xerox \$4.60. 86 pages.

# SEED-HEAD DEVELOPMENT IN TALL FESCUE AS INFLUENCED BY DATE OF APPLICATION OF 3 CHLORO IPC

(L. C. Card No. Mic 58-3051)

Samuel Jefferson Dunn, Ph.D.  
Oregon State College, 1958

Major Professor: J. Ritchie Cowan

The carbamates are known to reduce or practically eliminate seed-head formation in tall fescue when applied after October in the Willamette Valley of Oregon. This prevention of seed-head formation by 3 Chloro IPC (O-Isopropyl N-3-Chloro phenyl carbamate) has been used as a tool to study certain aspects of floral development in this species at different periods during the fall, winter and early spring.

A pot experiment was planned which consisted of two clonal lines of known seed-yielding potential in a randomized block design of six treatments and five replications. The treatments were composed of a control and five dates of application of 3 Chloro IPC at the rate of 4 pounds per acre. The dates of application were October 15, November 18, December 18, January 15 and February 18. The potted plants were embedded in sawdust contained in a rectangular bed that measured 7 x 44 feet and was approximately one foot above the ground. This bed was located in an open field in order that the plants would be exposed to the natural climatic conditions of the area.

Sampling of the shoots from the control plots for microscopic examination was begun on October 15. The sampling of shoots from each chemical treatment commenced one month after 3 Chloro IPC was applied and continued at monthly intervals until the middle of March.

Histological and morphological studies were made of plant material treated with low concentrations of 3 Chloro IPC at monthly intervals ranging from October 15 to March 17. The severity of damage produced by this mitotic inhibitor was found to be influenced by the position, activity, maturity and vascular connections of the tissues and tillers involved. Length of time after treatment was also an important factor. Mother shoots present at the time of treatment eventually died from the toxic effect of the chemical; however, propagation of the plants was continued by the production of tillers.

The apex of certain tillers sampled at the October date of treatment showed marked morphological differences from those sampled at later dates. Findings indicated that it was necessary for shoot apexes to reach a specific stage of development under certain environmental conditions before tillers became potentially capable of producing floral primordia.

Microfilm \$2.00; Xerox \$4.80. 94 pages.

THE EFFECTS OF CIPC, MONURON  
AND 2,4-D HERBICIDES ON YIELD, CRUDE  
PROTEIN AND NITRATE NITROGEN CONTENT  
OF FOUR FORAGE-CROP SPECIES

(L. C. Card No. Mic 58-3052)

William Ralph Furtick, Ph.D.  
Oregon State College, 1958

Major Professor: J. Ritchie Cowan

The effect of herbicides on the crude protein per cent, nitrate nitrogen content, and dry-matter yield of four forage species was studied. The herbicides 2,4-D, monuron, and CIPC were each applied at three dosages. Spring and fall treatments were compared on birdsfoot trefoil, Ladino clover, tall fescue, and orchardgrass under field conditions.

A greenhouse trial was carried out on four clonal lines of tall fescue. The four lines were treated with two rates of CIPC and monuron. The treated plants were harvested two, four, and six weeks after treatment. Each of the clonal lines comprised treated and non-treated plants fertilized with 60 pounds of actual nitrogen in the form of ammonium sulfate and unfertilized. Crude protein per cent was determined for the harvested foliage of the test plants.

Under field conditions, 2,4-D did not influence protein content or dry-matter yield of the four forage species. Both CIPC and monuron resulted in a yield reduction of the two grasses when applied in the spring. Fall applications of CIPC reduced the yield of tall fescue. The protein content of both grasses treated with CIPC or monuron in the spring was higher than the check. This was also true for fall applications of monuron. The nitrate nitrogen content of the two grasses was not changed by treatment with either CIPC or monuron.

The yield of the two legumes was reduced by both CIPC and monuron. Monuron was quite toxic to Ladino clover. The influence on yield was complicated by a heavy ryegrass infestation which was killed by both CIPC and monuron treatments. Pure samples of legumes harvested in 1955 for crude protein analysis showed no effect from treatments on Ladino clover. CIPC treatments on birdsfoot trefoil were higher in protein content.

In the greenhouse trial CIPC treatments resulted in an increased protein content of the tall fescue lines grown under high fertility. Monuron caused a marked increase in protein content under both levels of fertility. The increase was detected at the two-weeks harvest, and was maintained at the eight-weeks harvest.

Further study is suggested on the influence of CIPC and monuron on the physiology of grass plants as a means of finding an explanation for the changes in nitrogen metabolism. Microfilm \$2.00; Xerox \$4.40. 85 pages.

AMMONIUM FIXATION IN SOILS AND MINERALS

(L. C. Card No. Mic 58-3046)

Glen E. Leggett, Ph.D.  
State College of Washington, 1958

The  $\text{NH}_4$  fixing properties of soils and minerals were studied in regard to  $\text{NH}_4$  fixation and release of fixed  $\text{NH}_4$ . During the course of this investigation, the aeration principle for removing  $\text{NH}_3$  from alkaline soil suspensions was adapted for determining the  $\text{NH}_4$  fixing capacities of soils under moist conditions. The method consists of adding a known quantity of  $\text{NH}_4$  to a soil sample and then removing the soluble and readily exchangeable  $\text{NH}_4$  from the system by aeration using 5%  $\text{K}_2\text{CO}_3$  solution as the alkalizing agent. The  $\text{NH}_4$  fixing capacity of the soil is determined as follows:  $(\text{NH}_4 \text{ added}) - (\text{NH}_4 \text{ recovered}) = \text{fixed NH}_4$ . Results obtained by use of this procedure are comparable to those obtained by use of the N KCl extraction procedure. The proposed method is more rapid and requires less personal attention by the analyst than the N KCl extraction method, since the soluble and readily exchangeable  $\text{NH}_4$  can be removed overnight. Sufficiently accurate results are obtained from duplicate determinations even on soils high in organic matter.

It was shown that  $\text{NH}_4$  fixation by soils was affected by the concentration of the  $\text{NH}_4$  solution added to the soil; more  $\text{NH}_4$  was fixed from concentrated than dilute solutions. Greater fixation was also noted when the  $\text{NH}_4$  solution and soil were in contact for 24 hr. than for 1 hr. regardless of the concentration of the  $\text{NH}_4$  solution used. More  $\text{NH}_4$  was fixed by the soil when the source of  $\text{NH}_4$  was  $(\text{NH}_4)_2\text{HPO}_4$  than when equivalent concentrations of  $\text{NH}_4\text{OAc}$ ,  $\text{NH}_4\text{Cl}$ ,  $(\text{NH}_4)_2\text{SO}_4$ ,  $(\text{NH}_4)_2$  citrate, or  $(\text{NH}_4)_2$  tartrate were used.

Small amounts of K present with large amounts of Na were extremely effective in preventing release of fixed  $\text{NH}_4$  by Na from soils and vermiculite during alkaline distillation or aeration. When the K/Na ratio of the alkalizing agents was 0.02 or greater the release of fixed  $\text{NH}_4$  from Palouse and Cusick soils by Na was almost completely blocked. A higher K/Na ratio in the alkalizing solutions was necessary to prevent release of fixed  $\text{NH}_4$  from South African vermiculite. Data were given to indicate that in order for K to block release of fixed  $\text{NH}_4$ , it must become fixed itself, thereby maintaining a contracted mineral lattice.

Many soils found in Washington are capable of fixing  $\text{NH}_4$  under moist conditions. The  $\text{NH}_4$  fixing capacities of the surface layers for eight of the thirty soils studied were greater than 0.5 meq./100 g. Fixation usually increased with depth in the profile; the B horizons of some soils fixed more than 6.0 meq. of  $\text{NH}_4$  per 100 g. The  $\text{NH}_4$  fixing capacities of the various horizons of some soils of the Palouse loess reached a maximum in the B horizons. Below that depth the values decreased but were still higher than those for the surface horizons.

X-ray diffraction patterns of the Ca-saturated size fractions of Cusick and Palouse soils indicate the presence of a 14 A mineral in the 0.2-2.0 and 2-5  $\mu$  fractions. When saturated with  $\text{NH}_4$ , the 14 A mineral in the Palouse soil collapsed completely to a 10 A mineral, whereas that in the Cusick soil was only partially collapsed. Heating the Ca-saturated Cusick fractions to 500°C for two hours completely collapsed the 14 A mineral to a 10 A mineral.

It was concluded that the 14 A mineral present in these soils was vermiculite and that it was largely responsible for  $\text{NH}_4$  fixation in these soils. It was suggested that the vermiculite present in these soils was formed in situ through the removal of K from biotite by plant roots.

Many soils contain considerable amounts of HF extractable  $\text{NH}_4$  which is not released by alkaline distillation or aeration in the presence of Na. Removal of organic matter by  $\text{H}_2\text{O}_2$  did not affect the HF extractable  $\text{NH}_4$  significantly. It was concluded that the HF extractable  $\text{NH}_4$  was fixed  $\text{NH}_4$  released from the inorganic fraction of the soil. In view of the marked effect of K on the release of fixed  $\text{NH}_4$  by Na, it was concluded that the alkaline distillation and aeration procedures gave low results because of the K released from the soil.

Microfilm \$2.00; Xerox \$5.00. 97 pages.

# INHERITANCE OF COMBINING ABILITY FOR SEED CHARACTERISTICS IN BROMUS INERMIS LEYSS

(L. C. Card No. Mic 58-3012)

Arlan Kent Nielson, Ph.D.  
Iowa State College, 1958

Supervisor: Robert R. Kalton

Performance of topcross progenies of 18  $S_0$  clones of *Bromis inermis* Leyss. and 10  $S_1$  segregates from each and of 13 other  $S_0$  clones was evaluated for two years in a replicated, solid-planted test. Nine varieties and synthetics also were included as checks. Major objectives were to determine extent of variation and segregation for combining ability for seed yield, panicle number, fertility and seed weight.

As an average for two years, ranges in topcross performance were: 138 to 685 pounds of seed per acre, 62 to 237 panicles per four square feet, 44.3 to 74.8% in fertility and .262 to .324 grams per 100 seeds. Mean differences among  $S_0$  topcrosses and among  $S_1$  topcrosses within families on a combined basis were significant at the 5 or 1% level for all characters, indicating extensive genetic variation for combining ability. In most instances, differences among  $S_1$  topcrosses within families also were significant at the 5 or 1% level in individual family analyses, which is evidence of segregation for combining ability. Thus, despite its irregular meiotic behavior, bromegrass appears to exhibit wide variation and extensive segregation for combining ability for seed traits. Comparison of topcross performance of  $S_0$  and  $S_1$  selections suggested that one generation of inbreeding was not necessary to obtain lines superior in combining ability and, for fertility, might be deleterious. In general, topcrosses of  $S_1$  selections significantly exceeded their respective  $S_0$  topcrosses only when the latter were low. Further evidence of the needlessness of inbreeding was provided by the proportionately equal number of  $S_0$  and  $S_1$  topcrosses superior to the Fischer check.

Genetic correlations between seed yield and panicle number were 0.80 and 0.69 and were 0.73 and 0.41 between seed yield and fertility for 1956 and 1957, indicating that both traits are important components of seed yield. Seed

weight appeared to be independent of seed yield. Heritability values, based on regression of  $S_1$  on  $S_0$ , were 32, 38, 67 and 83% for combining ability for seed yield, panicle number, seed weight and fertility, respectively. Inter-annual correlations ranged from 0.58 to 0.68 and suggested the possibility of eliminating selections low in combining ability on the basis of one year's test. However, significant years x families mean squares indicated that at least two years of testing would be desirable for more critical evaluation.

Comparison of performance in this test with results obtained from previous testing of parental material pointed out that selection for combining ability for panicle number must be based on progeny testing. It appears possible, however, to improve combining ability for fertility by selection in clonal nurseries. It was concluded that ample opportunity appears to exist for utilizing the material investigated in recurrent selection programs with promise of obtaining synthetics superior in one or in all of the seed characters studied.

Microfilm \$2.00; Xerox 5.40. 107 pages.

# DRY MATTER AND NITROGEN PRODUCTION BY LEGUME ASSOCIATIONS AS RELATED TO CORN YIELDS

(L. C. Card No. Mic 58-3020)

Fred Charles Stickler, Ph.D.  
Iowa State College, 1958

Supervisors: I. J. Johnson and W. D. Shrader

An investigation was conducted at two locations in the Clarion-Webster soil association area from 1955 through 1957. Major objectives were to measure the quantitative growth characteristics of legumes grown alone and in association and to compare following corn yields with those produced by an inorganic nitrogen source.

Results from five green manure experiments reaffirmed the value of sweetclover as a legume green manure. Total nitrogen yields ranged from 111 to 188 pounds per acre. Total nitrogen yields of the non-hardy alfalfas varied from 15 to 146 pounds per acre while those of the hardy variety, Ranger, varied from 14 to 103 pounds per acre. Red clover and Ladino white clover total nitrogen yields ranged from 24 to 82 and from 13 to 63 pounds per acre, respectively.

Israel sweetclover produced higher nitrogen yields than did another annual variety, Hubam, but both were found inferior to Madrid, a biennial variety.

Generally none of the legume associations yielded as well as Madrid sweetclover grown alone and Madrid sweetclover was the major component of associations in which it was included.

A statistical evaluation of competitive relationships within two-component associations indicated that the net result of competition was generally compensating in nature, with little evidence for the existence of mutually beneficial or antagonistic associations.

Clipping drastically reduced dry matter and nitrogen yields of Madrid sweetclover but increased those of other

legumes. Clipping also influenced the fall nitrogen percentage of legume tops and roots.

Significant corn yield responses were obtained in each corn response experiment with 75 or 100 pounds of inorganic nitrogen generally resulting in highest yields.

The mean inorganic nitrogen equivalent for 19 green manure seedings as estimated from curvilinear regression was approximately 34 pounds per acre in first-year corn evaluations and 64 pounds in second-year residual tests.

The availability ratio of inorganic and green manure nitrogen estimated from concurrent linear regressions varied from 2.06 to 6.00 in favor of inorganic nitrogen. Nitrogen source did not influence the relationship between grain yield and leaf nitrogen percentage. Regression

analysis revealed an influence of legume nitrogen on the following corn crop that was not accounted for in the estimation of legume nitrogen yields.

In a laboratory experiment, genotype was found to influence nitrate release from leguminous residues. Greater release was obtained from tops than from roots. Immobilization of nitrate nitrogen was less intense and recovery of added nitrogen was greater with coarsely ground materials than with fine particle sizes. Statistical analysis of net nitrate release data from different stages of decomposition indicated that the important differences among the various treatments occurred only in the early stages of decomposition.

Microfilm \$2.75; Xerox \$9.40. 209 pages.

## ANATOMY

### EFFECTS OF OTHER HORMONES ON TESTICULAR RECOVERY CAUSED BY TESTOSTERONE PROPIONATE IN HYPOPHYSECTOMIZED RATS

(L. C. Card No. Mic 58-2952)

Anthony Vincent Boccabella, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Warren O. Nelson

Sprague-Dawley rats which had been hypophysectomized for 65 days and treated daily with 3 mg. of testosterone propionate for another 35 days showed a restoration of spermiogenesis up to the acrosome phase. These results were not appreciably influenced by any of the diets used in this study, whether fed ad libitum or force-fed.

Growth hormone, thyroxine, prolactin and cortisone when given separately did not alter the spermatogenic picture seen in the hypophysectomized rats.

Growth hormone and testosterone propionate were found to act synergistically on the testis only when the animals were fed a horse meat-orange diet ad libitum. Histological examination of the testes of these animals showed that spermiogenesis had proceeded to the maturation phase. The increase in testicular weight was found to be significantly greater than in the animals given testosterone propionate alone. When the testicular weights were calculated on a 100 gm. body weight basis there was no significant difference among the treated animals. Since the increase in testicular weights repeatedly coincided with an increase in body weight, it was suggested that the effect of growth hormone on the testis was merely a manifestation of its somatotrophic effect.

A preliminary quantitative analysis of germinal cells in a cross section of seminiferous tubules in stages 7 or 8 of the spermatogenic cycle of a rat treated simultaneously with growth hormone and testosterone propionate demonstrated more type B spermatogonia than in the seminiferous tubules of an animal treated with testosterone propionate alone. It is therefore suggested that growth hormone might possibly have influenced the spermatogonia to divide

directly or indirectly by presenting better homeostatic conditions.

Administration of thyroxine repeatedly resulted in an augmentation of the effect of testosterone propionate on testis weights in rats on a medium carbohydrate diet. Histologically, the development of the spermatids was also promoted to more advanced stages of spermiogenesis. The testicular weights per 100 gm. of body weight of the animals given testosterone propionate alone or with thyroxine were considerably heavier than those of the hypophysectomized controls but not significantly different from each other. The effect of thyroxine appears to be due to its ability to improve the intestinal absorption of food and/or increase the metabolic rate of the hypophysectomized rat.

Intratesticular implants of 100% testosterone pellets weighing 10 mg. improved spermatogenesis in both testes. Growth hormone given to rats with pellet implants led to the heaviest testicular and accessory gland weights. This is attributed to the ability of growth hormone to increase the absorption of the testosterone pellet. Administration of thyroxine did not influence the absorption of the pellet and failed to affect testicular and accessory gland weight.

The simultaneous administration of prolactin plus testosterone propionate resulted in testicular and prostatic weights which suggested the possible existence of a synergism between the two hormones. However the effect of prolactin was not significant statistically.

Whenever growth hormone or thyroxine acted synergistically with testosterone propionate to produce greater testicular weights the prostate also responded in the same manner.

Although testosterone propionate did improve spermatogenesis, a complete recovery was never obtained. Growth hormone and/or thyroxine, when simultaneously administered with testosterone propionate, resulted in a restoration of spermatogenesis which was definitely superior to the restoration induced by testosterone propionate only. However these additional hormones did not produce an effect as good as that seen in the testes of animals suitably treated with a combination of the FSH and CG.

Microfilm \$2.00; Xerox \$4.60. 88 pages.

**EXPERIMENTAL STUDIES ON THE DOG  
AND RAT CONCERNING THE RELATIONSHIP  
OF ENAMEL PERMEABILITY TO  
DENTAL CARIES**

(L. C. Card No. Mic 58-2901)

Harold Eugene Brewer, Ph.D.  
Indiana University, 1958

The three experimental methods, i.e., microcrystallographic, conductance bridge, and amplifier-recorder, used in these studies have shown that the permeability of dental enamel was decreased by exposure of the external enamel surface to aqueous solutions of sodium fluoride and stannous fluoride. The ability of sodium fluoride to decrease the entrance into or passage of ions through enamel was less than that of stannous fluoride. Since stannous chloride also reduced the ionic permeability of enamel, it seems likely that the stannous ion, as well as fluoride, is concerned in the permeability-reducing effect of stannous fluoride. The data suggest that the antipermeability effects of fluoride compounds may explain their anticariogenic ability.

Present findings relative to the permeability of human enamel to sucrose clearly indicate that this carbohydrate may penetrate the external enamel surface and pass centripetally to the pulp chamber. Penetration of sugars into enamel could be of significance in the caries process for the sugar could serve as a substrate for acid-producing bacteria in such location. However, other data indicated that the presence of sucrose around the tooth, or exposure of the tooth to the sugar for short time intervals, decreased subsequent passage of sodium and chloride ions into the enamel. It is thus apparent that the role of carbohydrates in the dental caries process may be more complex than serving as bacterial substrate.

Whether the centripetal permeability of the teeth may be altered by changes in their vascular supply was studied in dogs. Data obtained showed that ions from a sodium chloride solution passed through the crowns of teeth which had the artery supplying them ligated at a faster rate as compared with contra lateral normal cuspids. Severance of the nerve supplying the teeth or venous obstruction was apparently without effect on enamel or dentin permeability. In no instance was a decrease in permeability observed as a result of arterial ligations. The permeability either increased or remained unchanged as in three animals studied.

No difference in the thickness or density of the enamel or permeable and relatively impermeable teeth from the experimental animals were evidenced in radiographs. The films did reveal that dentin may be affected by changes in the vascular supply to the teeth. The experimental teeth from 25 per cent of the dogs showed internal resorption of primary dentin whereas contralateral teeth were radiographically and microscopically normal.

In order to determine whether changes in the blood supply to the teeth were related to dental caries experience, arteries supplying the molar teeth of rats were ligated. In all studies the molars of these animals exhibited increased caries incidence. This was true when comparing caries incidence in operated and non-operated animals and when considering caries incidence in animals having the dental arteries ligated unilaterally. Both the number of teeth affected by caries as well as the extent of the carious lesions were greater in animals having the

ligation operations. It thus seems likely that the tooth, including the enamel, like other vital tissues and organs, is responsive to alterations in its vascular supply.

Microfilm \$2.40; Xerox \$8.40. 182 pages.

**THE EFFECTS OF  
HYPOPHYSECTOMY AND ADMINISTRATION  
OF PILOCARPINE ON THE PAROTID  
GLAND OF THE RAT: A HISTOCHEMICAL  
AND BIOCHEMICAL STUDY**

(L. C. Card No. Mic 58-3653)

Maynard Merle Dewey, Ph.D.  
University of Michigan, 1958

The objectives of this study were (a) to elucidate the complex histochemical and biochemical changes which occur in the parotid gland after hypophysectomy, (b) to provide basic information for a re-evaluation of the possible endocrine role of the parotid gland and (c) to reconsider the effects of the administration of pilocarpine with the aid of newer histochemical techniques.

Histochemical procedures for ribonucleic acid, sulfhydryl and disulfide groups, carbohydrate-containing proteins, alkaline phosphatase, non-specific esterase, and succinic dehydrogenase were employed as well as procedures for the demonstration of zymogenic granules and mitochondria. A biochemical quantification and a separation by starch gel electrophoresis of the esterases of the parotid gland were performed.

A marked atrophy of the acinar cell occurred after hypophysectomy. This was evidenced by reduced cellular size and reduction in number, size, carbohydrate content and affinity for aniline blue of its zymogenic granules. No change was observed in the other parameters measured except a marked reduction in the alkaline phosphatase content of the myoepithelial cells and capillaries associated with the acinar cells.

A partial depletion of the cytoplasmic granules of the intercalated duct cells was also observed. No other defects were observed. There was no atrophy of the salivary ducts as shown by a lack of significant change in either cell height or duct width. Cytologic and chemical alterations were observed, however, in the salivary and interlobular ducts including a decrease in affinity for leucofuchsin subsequent to periodic acid oxidation, slightly reduced ribonucleic acid, accumulation of glycogen and markedly depressed esterase. Similar effects were seen in the excretory ducts with the exception of the reduced esterase activity.

Two esterase-active proteins were demonstrated by starch gel electrophoresis. Hypophysectomy did not alter these in any way. Nor did it significantly alter the esterase content of the gland. A tendency toward a reduction was evident due to the reduced activity of the salivary and interlobular ducts. This was offset by the increased basal concentration of this enzyme in the acinar cells.

It was concluded that the degree of control by the hypophysis over the parotid gland, exerted either directly or indirectly through its dependent glands, is different from that over other enzyme-producing cells. The gastric chief cells, pancreatic acini, and serous tubules of the

submandibular gland undergo a much greater morphologic change after hypophysectomy than does the parotid.

No evidence was obtained to support or reject the postulated endocrine role of the parotid. The lack of more marked changes in the salivary ducts is, however, evidence against such a concept, as they, under the tropic control of the anterior hypophysis, are reported to be the source of a salivary gland hormone (parotin).

The administration of pilocarpine affects both the acinar cells and the duct system. Degranulation was observed in both the acini and the intercalated duct cells. An increase in the ribonucleic acid content of both acinar cells and duct cells occurred. Alteration in the position of the nucleus and mitochondria as well as an accumulation of glycogen was observed in the salivary, interlobular and excretory ducts.

Microfilm \$2.00; Xerox \$3.60. 65 pages.

**STUDIES UPON IMPLANTED OVARIAN  
TISSUE IN SPAYED ALBINO RATS,  
FOLLOWING CULTIVATION IN VITRO FOR  
VARYING LENGTHS OF TIME**

(L. C. Card No. Mic 58-2745)

Aroon Ekchandra Santadusit, Ph.D.  
Duke University, 1958

Supervisors: Kenneth L. Duke and  
Duncan C. Hetherington

A review of the literature shows that ovarian tissue may be subjected for relatively short periods of time to various treatments prior to being grafted into a prepared host and still give evidence of hormonal activity if the graft "takes" in its new environment. Payne and Meyer (1942) demonstrated that ovarian tissue removed from 28-32 day-old rats could be cultivated at 37°C by the roller tube method for 2-5 days. Such tissue transplanted into the anterior chamber of the eyes of spayed hosts became functional after a time as evidenced by changes in the vaginal mucosa indicative of the estrous cycle.

No reports in the literature have indicated how long ovarian tissue may be cultivated outside the body and still be capable, when grafted into a suitably prepared host, of developing into a hormone producing structure with the capacity of changing the erstwhile anestrus host into one manifesting the effects of ovarian activity, such as recurrent estrous cycles. It was this topic which engaged the author's interest and the results of her research form the subject of this dissertation.

White rats of the Osborne-Mendel strain, 35-45 days of age, were spayed. The ovaries were divided into portions approximately 1mm<sup>3</sup> in size and cultivated at 37°C., using

a modification of the method of Fell, Gaillard and Martino-vitch for periods of 5, 10, 15, 20 and 30 days. After each one of these intervals each member of a group of animals spayed 21-30 days previously, received intrarenally, one portion of cultured ovary. Control animals received a portion of uncultivated, fresh ovary. Vaginal smear records were kept on all animals before and after grafting. A total of 96 animals received implants; of these 8 were autografts; 88 intrastrain homografts. The results are briefly as follows:

No. Hosts	Kind of graft	Takes	Latency in days	Average days before functioning
8	Autografts	8	6-12	9.0
	9-10 day cultures			
17	Immediate	17	5-8	6.5
18	5 day culture	15	6-12	9.0
17	10 " "	14	6-20	13.0
17	15 " "	10	7-23	15.0
12	20 " "	6	10-28	19.0
7	30 " "	0		

All autografts were active. Five of the 8 animals were observed for a period of 8 months and at the time of sacrifice the grafts were still active. The other groups of animals were observed after grafting never less than 35 days nor more than 75 days. The number of "takes" decreased with increased time of pre-cultivation while the latent period progressively increased. Autografted animals were more regularly cyclic than homografted animals.

At the termination of any one experiment the graft, the uterus and vagina of each host were prepared and examined histologically. The grafts were always sectioned serially.

The histological features of all functional grafts resembled closely the architecture of the intact ovary. There were no marked differences between the histological appearances of functional grafts arising from either the uncultured immediate grafts or the precultivated ones. The numbers of normal primordial and growing follicles seemed to be decreased respectively in the grafts arising from tissues precultivated for progressively longer periods. The normal process of growth and development until maturation and formation of corpora lutea was noted in most of the active grafts. The evidence of actual rupturing of follicles was found in only one host, bearing a 15-day precultivated graft. The result of imbalance between the gonadotropic hormone from the pituitary of the host and the hormones produced by the graft was frequently observed as indicated by the occurrence of various abnormal structures such as atretic follicles, frustrated follicles with retained ova, and cysts both follicular and lutein, with or without hemorrhage.

Microfilm \$2.00; Xerox \$5.40. 107 pages.

## ASTRONOMY

### THE DISTRIBUTION OF INTENSITY IN ELLIPTICAL GALAXIES OF THE VIRGO CLUSTER

(L. C. Card No. Mic 58-3672)

Martha Locke Hazen, Ph.D.  
University of Michigan, 1958

This thesis presents a study of the distribution of surface intensity in the larger elliptical galaxies of the Virgo Cluster. Such observational material is important in the testing or derivation of theories of the structure of elliptical galaxies.

Fifteen of the brightest elliptical galaxies in the Virgo Cluster were chosen for this study, as well as nine spiral and barred spiral galaxies for comparison purposes. Photometrically calibrated blue plates taken with the 24-inch Curtis Schmidt telescope of the University of Michigan were used and also blue plates taken with the 48-inch Schmidt telescope of the Mount Palomar Observatory. The zero point of the photometric calibration curve for the Curtis Schmidt plates was set by a photoelectric determination of the brightness of the night sky. The Palomar Schmidt plates were calibrated by the use of intensity distributions in six standard galaxies as derived from the Curtis Schmidt plates. Isophotal contours were drawn for the galaxies with the University of Michigan isophotometer. The faintest contours recorded are about three per cent of the intensity of the sky background. The intensity data from different plates agree to about one tenth of a magnitude.

For each galaxy, the surface brightness, ellipticity and position angle has been tabulated as a function of the major axis of the corresponding isophote. Integrated magnitudes for several of the galaxies have been determined. A criterion of relative distance to clusters of galaxies has been derived.

In addition, from several independent arguments it has been concluded that the largest elliptical galaxies in the Virgo Cluster are of globular form; the lenticular, or highly oblate spheroidal, systems are to be found among somewhat smaller and fainter galaxies. Three of these lenticular systems have been observed in "edge-on" projection. Such systems in "face-on" projection were not observed; they undoubtedly were too small for inclusion in this study. Finally, three-dimensional luminosity distributions for the globular galaxies and also for the lenticular systems have been derived from the observed intensity and ellipticity data.

A program for future work on the distribution of intensity in elliptical galaxies is outlined. This program would test the results obtained here and apply the methods of analysis described in this thesis to the study of elliptical galaxies in clusters and in the general field.

Microfilm \$2.00; Xerox \$5.40. 107 pages.

### A STUDY OF THE RATIO OF HELIUM TO HYDROGEN IN THE ATMOSPHERES OF THE B STARS

(L. C. Card No. Mic 58-3681)

Jun Jugaku, Ph.D.  
University of Michigan, 1958

Theories of the origin of the elements, either according to the Gamow type of hypothesis or by nucleogenesis in stars, predict that helium and heavier elements are produced from hydrogen. If the first theory is correct, the abundance ratio of helium to hydrogen is essentially the same now as it was when the earth was formed. If elements are being built in stars, the newly formed B stars should have a higher abundance ratio of helium to hydrogen than has the sun or other old stars. The purpose of the present investigation is to discuss the abundance ratio of helium to hydrogen in the atmospheres of certain B-type stars.

The line profiles of hydrogen and ionized helium and the total intensities (equivalent widths) of neutral helium and silicon lines have been utilized for this program. The data were obtained from spectrograms secured at the Mt. Wilson Observatory of the Carnegie Institution of Washington. The plates were taken with the coudé spectrograph of the 100" telescope, in which the all-mirror optical system permits one to observe the spectrum from  $\lambda 6800$  to  $\lambda 3500$ . The dispersion is 5.7 Å/mm in the visual region  $\lambda \lambda 4900-6800$  and 2.8 Å/mm in the photographic region. A total of twenty-five plates has been obtained for the stars  $\gamma$  Pegasi, 22 Orionis, 114 Tauri, and  $\tau$  Scorpii. For  $\tau$  Scorpii, five additional plates obtained at the McDonald Observatory have also been used. These stars range in effective temperature from 20,000° to 34,000° approximately. All have surface gravities in the neighborhood of  $2 \times 10^4$  cm/sec<sup>2</sup>.

The method of analysis is based on the theory of absorption line formation in a model atmosphere in which the dependence of pressure and temperature on the depth is a known function. Since the model appropriate to any specific star is not known a priori, the profiles of the H $\gamma$  line and the total intensities of certain silicon lines have been computed for several models. The Balmer line profiles are very sensitive to surface gravity and rather insensitive to temperature for stars in this temperature range. On the other hand, the relative intensities of the observable lines of Si II, Si III, and Si IV are very sensitive to temperature but not to surface gravity. Hence, the effective temperature and surface gravity for each star can be found by a comparison of the observed and predicted H $\gamma$  profiles and silicon line intensities.

The intensities of neutral helium lines have been calculated with the aid of Pecker's precise theory of the curve of growth. Six lines of neutral helium, namely,  $\lambda \lambda 3448, 3614, 4438, 4713, 5016, \text{ and } 5048$ , have been selected

to find the abundance of helium. A formal application of the theory gives the abundance ratio of helium to hydrogen by number as 0.12 for  $\tau$  Scorpii, and 0.16 for  $\gamma$  Pegasi. However, these values cannot be accepted as conclusive since the line broadening parameters are not well enough known. The profiles and total intensities of two ionized helium lines,  $\lambda 4686$  and  $\lambda 4542$ , also have been discussed. They are sensitive to the assumed effective temperature of the star, and no clear-cut evidence was found to determine the abundance ratio of helium to hydrogen. It is concluded that the situation can only be improved when more reliable data for the mechanism of line broadening are available.

Microfilm \$2.00; Xerox \$6.80. 144 pages.

#### A STUDY OF LINE INTENSITIES AND LINE PROFILES IN THE SPECTRUM OF PROCYON

(L. C. Card No. Mic 58-2935)

Leon William Schroeder, Ph.D.  
Indiana University, 1958

Equivalent widths have been measured for 114 lines of neutral titanium, chromium, and iron in the spectrum of Procyon. Lines studied were those for which laboratory absolute  $f$ -values have been determined. The spectral region covered is from 4000Å to 5450Å. The observations were fitted to the idealized curves of growth based on the model atmospheres of Milne-Eddington and of Schuster-Schwarzschild, for the cases of pure scattering and pure absorption.

Determinations of damping, kinetic velocities, excitation temperatures, and abundances were made for the four models employed. Results do not definitely indicate which model is to be preferred.

Recently the observed solar profiles of the magnesium triplet at  $\lambda 5175$  have been reproduced. The theoretical profiles were calculated on the IBM 650 electronic calculator using a model atmosphere, an assumed abundance for magnesium, and the necessary atomic parameters. The stratification of the model atmosphere was taken into account.

In this paper investigation is made of the possibility of duplicating the "detailed" profiles by the simpler procedure of using Milne-Eddington pure absorption profiles with parameters determined at a particular depth in the same model atmosphere.

An electronic calculator was used to facilitate making many trials with different parameters. The appropriate optical depth was found by trial and error to be 0.80. Two of the parameters can be obtained from the model atmosphere; the third from the observed central line intensities.

The results of the solar study were extended to the spectrum of Procyon where the same lines were duplicated using parameters from a Procyon model atmosphere.

Microfilm \$2.00; Xerox \$5.20. 102 pages.

#### AN EVOLUTIONARY SEQUENCE OF SOLAR MODELS

(L. C. Card No. Mic 58-2936)

Richard Langley Sears, Ph.D.  
Indiana University, 1958

The differential equations for the stellar interior have been integrated using the IBM 650 calculator at the Research Computing Center, Indiana University. An evolutionary sequence of models of solar mass has been obtained with successively decreasing hydrogen contents. The first, chemically homogeneous model, represents a primeval sun close to the age-zero main sequence defined by the Hyades cluster. Succeeding inhomogeneous models represent the course of evolution of the sun throughout the past 4.5 billion years to its present state.

The initial composition was taken to be 75% hydrogen and 23.5% helium, by mass. The models consist of interior portions in radiative equilibrium and convective envelopes characterized by the adiabatic relation  $P = KT^{2.5}$ , where  $\ln K = -5.0654$  was chosen such that the initial model fell close to the age-zero main sequence and was kept constant for all models. Interpolation formulas for the constitutive relations were constructed by Mr. Jon A. Stewart to fit Keller-Meyerott opacities for the relevant compositions and to fit the energy-generation expression for the proton-proton chain as given by Burbidge, Burbidge, Fowler, and Hoyle. The integrations were carried out in logarithms of the physical variables and required about 40 minutes each on the 650, using a Runge-Kutta integration routine written by Wrubel. Fitting of inward and outward integrations was performed in the manner used by Haselgrove and Hoyle.

A sequence of four models was constructed, with time intervals of 1.5 billion years. The hydrogen content at the center decreased from 75% to 42% over the period of 4.5 billion years, the central temperature increased from 14.0 to 16.1 million degrees, and the central density rose from 98 to 179 gm/cm<sup>3</sup>. No convective core was found in the models. The temperature at the bottom of the convective envelope was less than 1.5 million degrees. The radius increased by 3% from the first to the last model, and the luminosity brightened by 42%, implying an increase in effective temperature of 9% at the earth.

The radius and luminosity of the last model were about 10% too small and too large, respectively, compared to the observed present sun. Homogeneous models computed with smaller values of  $K$  showed no significant changes in any of the parameters except an increase in the radius, and hence it is concluded that the radius discrepancy can be independently removed by adjusting  $K$ , to values not inconsistent with determinations from atmosphere investigations. Similarly, homology considerations indicate that the luminosity discrepancy can be reduced by small changes in the composition, to values not inconsistent with spectroscopic observations. It appears that the initial helium content of the sun was in the range 20-25%.

The evolutionary track of the models in the Hertzsprung-Russell diagram is essentially parallel to the main sequence. This is consistent with the observations, which place the sun within the scatter of the Hyades main sequence.

A model with a single 4.5-billion year time step was also computed. Compared to the last model of the sequence,

the luminosity is fainter by 4% and the other parameters differ by a smaller factor. We conclude that computation of a detailed sequence is not required for preliminary

studies of evolution phases of the range here considered, but is necessary to avoid systematic errors in accurate investigations. Microfilm \$2.00; Xerox \$6.00. 125 pages.

## BACTERIOLOGY

THE PHYSIOLOGICAL BASIS OF  
TOXIGENICITY OF CLOSTRIDIUM BOTULINUM  
TYPES A AND B

(L. C. Card No. Mic 58-3640)

Peter Richard Frank Bonventre, Ph.D.  
University of Michigan, 1958

The investigation was concerned primarily with quantitative estimations of growth and toxin synthesis in relation to the autolytic processes of Clostridium botulinum types A and B, the effect of certain physical and chemical environmental factors on these processes, and the possible function of the organisms' constitutive-enzyme complement in converting postulated, comparatively non-toxic "pro-toxins" into the active forms which possess such astonishing biological activity. Using conventional turbidimetric methods for estimation of growth and autolysis, and mouse assay for quantitation of botulinus toxin, the following results were obtained and conclusions reached:

The normal growth cycle of all strains of C. botulinum studied was characterized by a period of active cell multiplication immediately followed by autolysis of the cells which continued until such time as few or no viable organisms remained. Autolysis was established as an important mechanism for the liberation of the toxin by the observations that the toxicity of culture filtrates was proportional, not to cell numbers, but to the degree of autolysis; and that artificial disruption of cultures at the end of the exponential growth phase resulted in the liberation of large quantities of intracellular toxin. The low level of toxicity observed in young culture filtrates was attributed to simple diffusion of the toxin from the cell into the external environment.

Glucose was found to be a specific requirement for toxin synthesis. A number of other carbohydrates were unable to replace the glucose requirement. The pH of the culture media, within the limits which supported growth, did not affect synthesis of botulinus toxin; however, pH indirectly affected the toxicity of culture filtrates by virtue of the narrow pH optimum for activity of the autolytic enzymes and the instability of the toxin in an alkaline environment. The maximum temperature at which growth of the organism occurred was 48 C at which temperature the toxin was gradually inactivated. Between 28 and 40 C, growth, autolysis and toxin synthesis were optimally supported. At 10 C or below, metabolic activity was not detectable while temperatures fluctuating between 10 and 18 C partially supported growth and toxin synthesis.

The tremendous increase in toxicity of the culture filtrates during the period of cellular degeneration could not be attributed to de novo synthesis of protein since this increase was apparent in the presence of chloramphenicol, a

known inhibitor of protein synthesis. Furthermore, no increases in total protein could be demonstrated during the period of active autolysis. The potential toxicity of cultures in the exponential growth phase was found to be much greater than their apparent toxicity. This was demonstrated by an 100-fold increase in toxicity obtained after artificial disruption of the cells followed by treatment of the cell-extracts with proteolytic enzymes. The activation of toxin by trypsin or pepsin could only be accomplished with young culture filtrates. It was concluded that the toxin of autolyzed cultures had been activated by the organisms' proteolytic enzymes and consequently could not be activated any further. The activation phenomenon could not be demonstrated by other than enzymatic means. Versene, which inhibited increases in toxicity of cell suspensions was found also to inhibit the proteolytic and autolytic enzyme systems of the organisms. Chloramphenicol completely inhibited any increases in total protein of cultures of C. botulinum. On the basis of this experimental evidence it was concluded that the biologically active toxins of C. botulinum types A and B are initially synthesized as large molecules which exhibit comparatively little toxicity. These toxin precursors must then be partially degraded, probably by the proteolytic enzymes of the organisms, before manifesting their full toxic potentialities. Microfilm \$2.00; Xerox \$7.00. 146 pages.

ISOLATION, CHARACTERIZATION AND  
METABOLISM OF METHANE OXIDIZING  
BACTERIA

(L. C. Card No. Mic 58-2838)

Lewis Raymond Brown, Ph.D.  
Louisiana State University, 1958

Supervisor: Professor Raymond J. Strawinski

The isolation and pure culture study of organisms capable of oxidizing methane has been fraught with difficulties. After an extensive study of isolation procedures, a method was devised whereby a methane oxidizing bacterium can be routinely isolated from soil by the basic enrichment procedure in combination with (1) shake incubation, (2) dilution to extinction to eliminate contaminating forms, (3) use of a micromanipulator to pick resultant colonies and (4) evaluation by chemical analysis of methane consumption as final proof of isolation of the desired cultures. Although several different methods of isolation were subsequently employed, the only pure cultures of methane oxidizing bacteria that were isolated proved

to be indistinguishable from those obtained by the method given above.

The name *Methanomonas methanooxidans* n. sp. was given to this polar flagellated non-spore-forming rod (1.5-3.0  $\mu$  in length by 1.0  $\mu$  in width). It stains unevenly with the gram stain and is non-acid fast. The bacterium did not grow on nutrient agar and formed only microcolonies on mineral salts agar even after prolonged incubation in the presence of methane. The addition of various organic and inorganic adjuncts to the medium failed to enhance colonization. It was found that the bacterium would form macrocolonies (up to 1 mm in diameter) on the routine mineral salts medium if, either the distilled water employed in preparing the medium was de-ionized or 0.02 per cent sodium chloride was added. By employing a solid substrate which permitted colonization, it was possible to isolate *M. methanooxidans* by streaking directly from methane enrichment cultures.

Growing cultures consumed methane and oxygen in a ratio of 1 to 1.1. Approximately 15 per cent of the methane consumed was present terminally as carbon dioxide. Methanol was the only carbonaceous compound capable of supporting growth of the organism in the absence of methane. Potassium nitrate, ammonium chloride, peptone, l(+)-arginine, l(-)-cystine, L(-)-leucine and L-glutamate were capable of serving as sole nitrogen sources. A pH of 6.1, 30-37 C and shake incubation were optimum for methane oxidation.

A study of the intermediary metabolism of the organism revealed that resting cell suspensions consumed methane and oxygen in a ratio of 1 to 1.66, respectively. The respiratory quotient (RQ) for methane was 0.43. Resting cells were unable to oxidize any other organic compound tested except methanol, formaldehyde and formate. The optimum pH and RQ values for these substrates were methanol, pH 6.5, RQ 0.59; formaldehyde pH 6.0, RQ 0.73; formate pH 5.5, RQ 1.33. In the presence of sodium azide the RQ value for formate remained steady at 1.84.

It was shown that formic acid was detectable in test solutions after cell suspensions had metabolized methane, methanol and formaldehyde. By employing sodium sulfite as a trapping agent for formaldehyde, it was demonstrated that the cells convert 60 to 70 per cent of the methane or methanol consumed to formaldehyde. In the presence of iodoacetate, 70 per cent of the methane consumed by the cell suspension was present terminally as methanol. Thus it was shown that methanol, formaldehyde and formic acid are truly sequential intermediates in the oxidation of methane by *M. methanooxidans*.

Microfilm \$2.00; Xerox \$4.40. 82 pages.

#### THE PARTIAL PURIFICATION AND PROPERTIES OF THE ALPHA-GLUCOSIDASE OF *SACCHAROMYCES ITALICUS* Y1225

(L. C. Card No. Mic 58-3657)

Loretta Christine Ellias, Ph.D.  
University of Michigan, 1958

The purification of yeast alpha-glucosidase has progressed slowly due to the lability of the enzyme, to incomplete information on its stability and activity, and to

the unavailability of suitable experimental methods. This investigation was concerned not only with purifying the enzyme but also with elucidating those factors that contribute to its activity and stability.

This investigation dealt with the alpha-glucosidase of *Saccharomyces italicus* Y1225 since its control by the M gene has been studied, and it seemed desirable to undertake studies with a system simpler than the more complex one of *S. cerevisiae*.

Maltose-grown cells of *S. italicus* Y1225 were manually ground in Superbrite beads (Minnesota Mining Company, Type 110) and extracted four times in M/15 phosphate buffer at pH 6.8. After each extraction, the material was centrifuged at 32,000 x g in a Servall centrifuge. The composite supernatant fluid was then centrifuged for one hour at 120,000 x g in a Spinco preparative centrifuge. The supernatant fluid from Spinco treatment was subjected to repeated zone electrophoresis with starch as the supporting medium and M/15 pyrophosphate buffer at pH 8.4 as the electrophoretic buffer. This purification procedure effected a 105 fold purification of alpha-glucosidase. All purification experiments were carried out at 4° C.

After dialysis of the electrophoretic eluate, the purified alpha-glucosidase was used to define the properties of the enzyme.

Alpha-glucosidase activity was determined by Spiegelman's modification of Sharer's test for detecting phosphatase activity in milk.

After centrifugation at 120,000 x g for one hour, alpha-glucosidase has been solubilized with 92 percent of the activity in the supernatant fluid and only 8 percent in the pellet.

The enzyme does not possess a dialyzable co-factor as evidenced by the fact that addition of boiled enzyme extract to a dialyzed preparation or to electrophoretic eluate did not increase activity.

In addition, the sulfhydryl nature of the alpha-glucosidase was established by the observation that parachloromercuribenzoate (PCMB) and iodoacetate (IAA), both sulfhydryl-binding reagents, inactivated the enzyme. The PCMB inhibition was reversed by cysteine. A partial cysteine reversal of IAA inhibition was unexplained and warrants further investigation.

The maximum activity of the enzyme occurred between pH 6.4 and 6.8.

The effects of various anions and cations on the stability and activity of alpha-glucosidase were studied. NaCl in high concentration protected the enzyme, in contrast to KCl and NH<sub>4</sub>Cl, which contributed to its instability. CaCl<sub>2</sub> at 10<sup>-2</sup> stabilized alpha-glucosidase while at 10<sup>-3</sup> M the salt increased loss of enzyme stability. MgCl<sub>2</sub> and CoCl<sub>2</sub> in low concentration reduced alpha-glucosidase activity. (NH<sub>4</sub>)<sub>2</sub>SO<sub>4</sub> and KNO<sub>3</sub> in high concentration contributed to the loss of enzyme. Ba<sup>++</sup> and Zn<sup>++</sup> did not alter the stability of alpha-glucosidase.

K<sup>+</sup>, Na<sup>+</sup>, NH<sub>4</sub><sup>+</sup>, and Ba<sup>++</sup>, (all as chlorides) did not influence the activity of alpha-glucosidase. Ca<sup>++</sup>, Co<sup>++</sup>, and Zn<sup>++</sup> (as chlorides) inactivated the enzyme, and Mg<sup>++</sup> (as the chloride) at 10<sup>-3</sup> M enhanced enzyme activity by 18 percent. The sulfate ion, as either the sodium, ammonium, or potassium salt did not affect alpha-glucosidase activity, while the nitrate ion, as the sodium salt decreased activity by 50 percent.

The enzyme showed full activity in phosphate buffer and in veronal acetate buffer, decreased activity in malonate

and carbonate buffers, and no activity in Tris or Tris plus phosphate buffers. Ammonium phosphate buffer contributed to the stability of alpha-glucosidase.

Cysteine in 0.25 percent, and higher concentrations, inactivated alpha-glucosidase. The cysteine inactivation was totally reversed by malonate buffer and this observation suggests that malonate may serve as a stabilizer of alpha-glucosidase.

Purification of alpha-glucosidase on a more rational basis may be realized from the information obtained on the factors influencing the activity and stability of this enzyme.

Microfilm \$2.00; Xerox \$4.20. 78 pages.

#### MICROBIOLOGICAL ASSAY FOR DIETHYLSTILBESTROL

(L. C. Card No. Mic 58-2999)

Ladislav James Hanka, Ph.D.  
Iowa State College, 1958

Supervisor: W. R. Lockhart

Possibilities of microbiological assay for hormones and hormone-like compounds were investigated. Most of the investigation was done with diethylstilbestrol, but good preliminary results were obtained with progesterone.

In an endeavor to recover an organism with an absolute requirement for progesterone two isolates were established from soil samples which are able to utilize progesterone as a sole source of carbon. Two members of the genus *Sarcina* are strongly inhibited by this hormone. Since the inhibition is not completely specific it is not possible to use it as the basis for an assay of progesterone in samples of biological origin where the presence of other hormones might be expected. However, it could possibly be used for quantitative estimation of progesterone in pure samples.

A strain of *Staphylococcus aureus* is strongly and specifically inhibited by diethylstilbestrol; this response was used as the basis for microbiological assay of this compound. Two types of assay technic were developed:

1. Broth assay able to detect differences of about 0.25 - 0.5 g/ml in diethylstilbestrol concentration among samples.
2. Disc-plate assay which can detect a concentration difference of 10 g/ml among samples as statistically significant at  $P = 0.05$ .

Attempts were made to adapt the assays for estimation of diethylstilbestrol in materials of biological significance and a feasible disc-plate assay was developed for estimation of this compound in feed supplements. The compound is extracted from feed samples with chloroform and a satisfactory purification is obtained by extraction with 0.1 N sodium hydroxide solution. The organization of a six-point and four-point parallel line assay is presented; the validity and the sensitivity limit of the assay were statistically verified by the analysis of variance. Two simple modifications of the assay for routine control work with feed supplements are described.

A mutant strain of the test organism was established which is highly resistant to aureomycin, though retaining

substantially unchanged its sensitivity to diethylstilbestrol. Using this mutant it should be possible to measure the amount of diethylstilbestrol in feed samples without interference from any aureomycin which is used in some feed supplements in addition to diethylstilbestrol.

The broth assay was used for measuring of samples of pure diethylstilbestrol and in a few assays for this compound in cow urine. The degree of inhibition is measured turbidimetrically and the results are presented in a six-point or four-point parallel line assay.

Microfilm \$2.00; Xerox \$4.00. 73 pages.

#### THE RESPONSES OF SOME SOIL MICROORGANISMS TO SODIUM 2,2-DICHLOROPROPIONATE AND MALEIC HYDRAZIDE DIETHANOLAMINE

(L. C. Card No. Mic 58-2847)

Lyman Abbott Magee, Ph.D.  
Louisiana State University, 1958

Supervisor: Dr. Arthur R. Colmer

Field studies with Dalapon (sodium 2,2-dichloropropionate) and MH-30 (maleic hydrazide diethanolamine) showed that repeated application of either herbicide in concentrations much higher than the recommended field application rates stimulated the multiplication of bacteria, molds, and actinomycetes in the soil.

Several strains of soil bacteria were isolated which could decompose the 2,2-dichloropropionate. Degradation of the Dalapon resulted in a decrease of the pH of solid and liquid media containing Dalapon as the carbon source, the release of chloride ion into the medium, and measurable respiration which showed that oxygen was consumed when Dalapon was the sole carbon source. Certain soil organisms, some of which could not be demonstrated to decompose Dalapon, associatively overcame the inhibition of an agar-decomposing soil bacterium by 2,000 ppm Dalapon.

The factors affecting polysaccharide formation by an MH-30-dissimilating bacterium identified as *Alcaligenes faecalis* were studied. It was found that a magnesium deficiency, the presence of ammonium sulfate, insufficient aeration of the culture, and temperatures above 27 C inhibited gum formation without appreciably altering the total cell count. Deficiencies of phosphate, calcium, molybdenum, and iron caused slight reductions in gum production. The nature of the carbon source in the medium had little effect on the extent of gum production, but the nitrogen source had a large influence on it, with the greatest amount of gum being formed in a medium containing peptone, a lesser amount being formed in media containing MH-30 or some other organic nitrogen compounds, and none being formed in media containing maleic hydrazide or ammonium sulfate as the nitrogen source.

Investigations on the nature of the gums produced by *Alcaligenes faecalis* showed that the gums were highly soluble in water, forming very viscous solutions, but insoluble in acetone or ethanol. The dried gums were tough and fibrous. The viscosity of the gum solution was slowly reduced as the temperature was increased; at 70 C there

was a marked decrease in viscosity and at 80 C the gum was permanently altered so that upon cooling to room temperature its viscosity was markedly increased. Chemical and chromatographic tests indicated that the gum comprised only glucose units.

Respiration studies with *Alcaligenes faecalis* indicated that cells grown in the presence of MH-30 showed a large

consumption of oxygen when maleic hydrazide was the carbon substrate, a small uptake with MH-30, and none with diethanolamine or maleic anhydride.

Chromatographic studies with Dalapon and MH-30 demonstrated the usefulness of this technique in detecting the herbicides and their related compounds.

Microfilm \$2.00; Xerox \$6.00. 122 pages.

## BIOLOGY — GENETICS

# INHERITANCE OF CHLOROPHYLL DEFICIENCIES AND OTHER GENETIC MARKERS IN *DACTYLIS GLOMERATA* L.

(L. C. Card No. Mic 58-2992)

Robin Louis Cuany, Ph.D.  
Iowa State College, 1958

Supervisors: Robert R. Kalton and Joseph G. O'Mara

In investigating the genetic structure of *Dactylis glomerata* L., selfed progenies were analyzed for potential marker traits. The most frequent abnormalities were chlorophyll deficiencies, which segregated from most non-inbred clones. Other seedling abnormalities were harsh dwarf and broad dwarf, both under apparent genetic control. Anthocyanin and fluorescence were too modifiable by environment to give useful genetic data. Early heading appeared to be genetically influenced, particularly in the progeny of Clone 121.

Chlorophyll deficiency phenotypes were described in seedlings, and where viable, in adults. Albino and luteus were characteristically lethal, while albobiridis, virescent and pale were vital, producing more or less vigorous adult plants which were usually distinct from normal adults. These five were found to be genetically controlled, segregating in ratios which were apparently unbiased by modified expression or differential germination. Information on viridis, banded, striate and striped was inconclusive.

The selection, clone 121, segregated 7,638 normal : 735 virescent : 187 albino. Detailed results from S<sub>1</sub> through S<sub>4</sub> generations indicated that normal plants may breed true or may segregate for only albino, or only virescent, or both types. There was no evidence of linkage between albino and virescent; the double deficient type was albino. Albino was inherited tetrasomically, with approximate ratios of 3 : 1, 35 : 1, 44 : 1 and 111 : 1. The two latter ratios were considered to be duplex ratios modified by preferential pairing in bivalents. Virescent inheritance was more complex, as ratios approaching 2 : 1, 3 : 1, 5 : 1, 10 : 1, 15 : 1, 33 : 1 and 100 : 1 were found. Virescent was recessive and bred true (except that some virescents segregated for albino). Complementary behavior at two loci, one tetrasomic and the other duplicate disomic, may have caused the 10 : 1 ratios. Modes of segregation for tetrasomic inheritance were discussed in relation to the known tendency of orchardgrass to form 3 to 4 quadrivalents per cell.

Limited data indicated that albobiridis was inherited on

a simple tetrasomic basis, with the recessive breeding true for albobiridis phenotype.

Glabrousness of glumes was considered to be recessive and true breeding. Small family size prevented a decision on the exact mode of segregation, as 3 : 1 ratios could be disomic or tetrasomic. The origin of the glabrous gene from diploid sub-species was discussed.

Using marker stocks as testers, outcrossing in a recombination block was over 98%, even in a clone with 46% self-fertility. An attempt was made to estimate randomness of cross-pollination.

The use of synthetic stocks homozygous for recessive virescent or albobiridis genes was suggested for measuring border effect and isolation distance required for seed multiplication. A glabrous-glume synthetic variety (easily recognizable in seed certification) might be made up from glabrous clones of high combining ability. Several other prospects of research in orchardgrass genetics were outlined.

Microfilm \$2.95; Xerox \$10.20. 226 pages.

# THE EFFECT OF DIETARY FACTORS UPON THE HORMONE CONTENT OF THE ANTERIOR PITUITARY

(L. C. Card No. Mic 58-3056)

Hugh Hampson Nicholson, Ph.D.  
Oregon State College, 1958

Major Professor: Ralph Bogart

The effect that nutrition has upon the hormone content of the anterior pituitary is important from the standpoint of how this effect would alter the expected genetic improvement in a selection program designed to improve economy and efficiency of gain in animals.

To determine if nutrition has such an effect the pituitaries were removed at slaughter from 36 steers that had been fed six different rations for a period of 125 days. These pituitaries were then assayed for thyrotrophin and gonadotrophin hormone content by injecting the macerated anterior pituitary gland subcutaneously into 4 day old chicks at three levels once daily for four days and measuring the amount of increase that occurred in the thyroids and testes of the assay chicks when compared to uninjected chicks.

Liver, thymus and adrenal glands were also removed at

time of autopsy of the chicks to determine if their weights were influenced by hormones of the injected pituitaries.

Results of the assay indicate that the levels of injection 0.003820, 0.007641, 0.015280 milligrams of the pituitary material caused a significant increase in the weights of the thyroids of the chicks, however the pituitary material from the six different rations did not produce a significant difference in thyroid weights of chicks.

Both the levels of injection and the different sources of pituitary material produced significant differences in testes weights of chicks. The high level of injection was the only level which produced testes heavier than those of uninjected chicks. The ration in which stilbestrol had been fed at 10 mg. per head per day was the only ration which produced a significant difference in the testes weight. There was no significant difference in the weights of the testes of chicks injected with pituitary material from animals fed the other 5 rations.

The fact that rations fed the steers had no influence on gonadotrophic or thyrotrophic hormone contents of the pituitaries, even though some rations were very low in protein content, indicates that a low-protein diet does not alter the hormonal activity of the pituitary gland.

It would appear from the observations made that the thymus and adrenal gland are not sufficiently influenced by anterior pituitary hormones to give them any value as indicators of pituitary hormone activity.

The weight of the livers of the injected chicks showed an increase in weight but this increase did not follow the level of injection. The reason for this occurrence was not apparent from the study made.

Microfilm \$2.00; Xerox \$3.80. 70 pages.

#### THE ANALYSES OF GROUPS OF SIMILAR EXPERIMENTS

(L. C. Card No. Mic 58-3014)

Basilio Alfonso Rojas, Ph.D.  
Iowa State College, 1958

Supervisor: Oscar Kempthorne

Tests of significance and estimation procedures for groups of experiments have been investigated in this study. The discussion is confined to agricultural experiments but generalization to other fields of research may be easily inferred.

The analysis of experiments must be based on a statistical model which must conform to the experimental situation with assumptions that are not in conflict with general knowledge. An investigation of a finite model was considered to bring to the surface the nature of the assumptions used in the analysis of groups of experiments. One conclusion was that heterogeneity of errors and interactions of treatments with places and years will be generally encountered.

The analysis of groups of experiments, under conditions of homogeneous uncorrelated errors and interactions as well as equal number of replicates in all experiments was considered. The general case of different numbers of experiments in each year was studied. Tests of significance and estimation of components of variance were considered

for different combinations of fixed and random variables in the statistical model used. The effects of disturbances arising by residual year effects and circular correlation among the errors in individual experiments were studied.

The unweighted analysis for groups of experiments with homogeneous experimental error variances and unequal numbers of replicates in the individual trials was studied. The estimation of components of variance and tests of significance are based on adjustments that depend on the number of replicates in each of the experiments of the group. Formulas were given to obtain such adjustments.

Heterogeneity of error variances in agricultural experiments was defined by assuming that place  $i$  has its particular error variance  $\sigma_i^2$ . Since the places are random variables the  $\sigma_i^2$ 's must follow a statistical distribution. The weighted analysis of variance and the variances of the weighted mean that have appeared in the literature have assumed heterogeneity of error variances but the authors have assumed a fixed set of  $\sigma_i^2$ 's. The method of weighted analysis was evaluated assuming the  $\sigma_i^2$ 's to be random variables, and the conclusion that its effectiveness is questionable in agricultural experiments was reached.

The properties of the mean squares in analysis of variance of groups of experiments were investigated when the error variances follow a gamma distribution. Some of the quadratic forms in the analysis of variance are distributed as the product of two independent gamma random variables. This distribution was studied and found to be very complex in general. An approximation was found by using its first two moments. With this approximation the tests of significance of general interest were reduced to usual ratios of mean squares which are approximately distributed as Snedecor's  $F$  with adjusted degrees of freedom. A method was given to compute the necessary adjustments. The method requires estimation of a scale parameter of the assumed gamma distribution and the estimation of this parameter is discussed.

Estimation procedures were investigated when the error variances follow a gamma distribution. The relative efficiencies of the weighted and semi-weighted means with respect to the unweighted mean were so found. A table and formulas were given to guide the experimenter in choosing any type of mean.

Microfilm \$2.20; Xerox \$7.60. 165 pages.

#### ROLE OF EGG "CYTOPLASM" IN TRANSMISSION OF RESISTANCE TO AN AVIAN LEUKOSIS TUMOR

(L. C. Card No. Mic 58-3017)

Eugene Chen Seu, Ph.D.  
Iowa State College, 1958

Supervisor: John W. Gowen

The role of the egg cytoplasm as well as the chromosomes in the transmission of resistance in the fowl to avian lymphomatosis strain RPL 12 was investigated. Supporting studies of the histology of the tumor and the relationships between the visceral, neural and ocular forms of the disease were made.

Reciprocal crosses were made between several inbred strains of chickens selected for resistance and susceptibility

to lymphomatosis. No cytoplasmic influence upon tumor mortality was detected in reciprocal crosses. Inoculation of dams also did not seem to influence the resistance of progeny obtained subsequently.

The importance of nuclear factors in determining resistance is strongly supported by the results of the genetic experiments. The several inbred strains of chickens used in this study appear to fall into three categories, highly resistant, intermediate, and highly susceptible. The highly resistant and susceptible strains behaved consistently in the several experiments conducted in different years and involving more than one generation. The strains intermediate in resistance gave less predictable results.

In crosses between the highly resistant and susceptible lines, resistance was largely dominant over susceptibility. When matings between resistant and susceptible birds were rearranged, such that resistant birds formerly mated to resistants were now mated to susceptibles, and susceptibles formerly mated to susceptibles were mated to resistants, dominance of resistance was also observed. The results indicate that the genes responsible were transmitted by both males and females.

No evidence of sex-linkage was observed.

Testcrosses of  $F_1$  birds mated to susceptibles were made. The limited amount of data obtained do not justify

any conclusion on the number of loci involved. However, considering the fact that the lines intermediate in resistance are unpredictable in crosses it appears that more than one locus is involved. On the other hand the existence of several susceptible lines together with dominance observed in certain crosses make it seem possible that resistance to this disease is determined by a small number of genes with major effects.

The tumor cells in fixed and stained sections and smears resembled large lymphocytes. The cells appeared to have large amounts of ribose nucleic acid in their cytoplasm. In some areas frequent mitoses were observed. When the cells were treated with colchicine, cells with bilobed nuclei were seen. The cells were also cultured on the chorioallantoic membrane of chick embryos and in depression slides. The tumor cells are relatively undifferentiated.

Nervous tissue from several birds showing signs of ocular lymphomatosis (grey eyes) were injected into the pectoral muscles of chicks. In one case tumor formation resulted at the site of injection as well as in the visceral organs. This particular case seems to support the view that visceral, neural and possibly ocular lymphomatosis are due to a single etiological agent.

Microfilm \$2.00; Xerox \$3.60. 64 pages.

## BOTANY

### STUDIES ON THE FUSARIUM DISEASES OF BULBOUS ORNAMENTAL CROPS

(L. C. Card No. Mic 58-3031)

Walter James Apt, Ph.D.  
State College of Washington, 1958

These studies deal with (1) the host range of the various forms of *Fusarium oxysporum* commonly found on six bulbous ornamental plants and (2) the influence of the H-ion concentration on the development of the *Fusarium* disease in bulbous iris.

Cross-inoculation tests with *Fusaria* from crocus (*Crocus sativus*), bulbous iris (*Iris* sp.), gladiolus (*Gladiolus* sp.), narcissus (*Narcissus pseudonarcissus*), lilies (*Lilium longiflorum*, *L. candidum*), and tulips (*Tulipa* sp.) were conducted with bulbs and corms of these six hosts.

The experimental results indicated that although some of the *Fusaria* were specific to one host, others had a more extensive host range. *Fusaria* from narcissus, lilies, and tulips were limited respectively to those hosts. *Fusarium* isolates from genera in the Iridaceae (*Crocus*, *Gladiolus*, *Iris*) were not only highly pathogenic on their original host but were also pathogenic on the other two genera in the Iridaceae.

According to the species concept of the *Fusaria* established by Snyder and Hansen, the name for the narcissus *Fusarium* is *Fusarium oxysporum* Schl. f. *narcissi*. Sny. & Hans; that of the form found on lilies is *Fusarium oxysporum* Schl. f. *lilii* Imle. The *Fusarium* basal rot disease in tulips is comparatively new and a form name has not been designated for the causal agent. On the basis that the

tulip *Fusarium* is highly pathogenic on tulips and on no other flowering bulb, the name *Fusarium oxysporum* Schl. f. *tulipae* n. f. is proposed for the fungus.

While the results of the cross-inoculation experiments showed that the three *Fusarium* isolates from the Iridaceae differed from each other in degree of pathogenicity, the author believes that the data is insufficient to justify the establishment of separate forms of *Fusarium oxysporum* for each isolate. Therefore, on the basis of usage and priority, the name *Fusarium oxysporum* Schl. f. *gladioli* Sny. & Hans. is proposed for the *Fusarium* affecting crocus, iris and gladiolus. The proposal is made with the qualification that additional work is needed.

In view of the results obtained with the *Fusarium* isolates from the Iridaceae, members of that family should not be grown in rotation where the basal rot fungus is known to be present.

The results of the H-ion studies showed that the basal rot disease of bulbous iris was manifested throughout the pH range of 4.0 to 8.0; but, symptoms were expressed first at pH 4.0 to pH 6.0 and the progress of the disease was very rapid at such levels. While the disease was also manifested at pH 7.0 and 8.0 before the experiments were terminated, its onset was much later and its progress markedly slower at the higher pH levels. The results obtained in the infection experiments were closely correlated with certain results in the laboratory. In the latter studies, it was shown that all three forms of *Fusarium oxysporum* tested, grew on a synthetic media with an initial pH range of 3.4 to 10.6, with the best growth occurring on the acid side of neutrality.

Microfilm \$2.00; Xerox \$4.60. 96 pages.

# ECOLOGICAL LIFE HISTORY OF PTEROSPORA ANDROMEDEA

(L. C. Card No. Mic 58-3032)

Trilochan Singh Bakshi, Ph.D.  
State College of Washington, 1958

*Pterospora andromedeae* Nutt. is the only species of this North American genus. A dot map prepared from the herbarium specimens showed that the species has a bi-centric distribution confined to cool temperate forests of eastern and western North America. The plant is characteristic of shady habitats and moist podzolic soils. It is sparsely distributed in the plant associations studied by the writer, and even less common in most other parts of its range.

Material for a study of the ecological life history of *Pterospora* was obtained in eastern Washington and adjacent Idaho.

After attaining maturity seeds remain alive for 3-9 weeks. Thirty-three treatments used in an effort to induce germination failed. Established seedlings have been observed in nature. The species is both monocarpic and polycarpic.

Chromosome counts during the first division of the microspore mother cells showed the diploid number to be 16.

Embryo sac development is of the *Polygonum* type. Various abnormalities including the bisporic type of embryo sac development were seen. The endosperm is cellular; embryogeny conforms to the *Aglaonema* variation of the Caryophyllad type. Not more than 4-5% of seeds in a capsule were found to be exembryonate. The development of the seed and its wing has been studied in detail.

*Pterospora* has a dense, spherical root mass from which long lateral roots producing shoots at various intervals, are given out. The roots have no organic connection with any other vascular plant. There is an unbroken mycelial sheath around each root so that *Pterospora* does not make direct contact with the soil. Attempts to isolate and identify the fungus were unsuccessful.

The anatomy of root, stem, leaf, and flower has been studied. There are extremely few stomata per unit area of leaf and stem. Spectrophotometric and paper chromatographic studies revealed the presence of  $\beta$ -carotene but the chlorophylls were found to be absent.

The marked reduction in leaves and in number of stomata per unit area appears to be associated with the absence of chlorophyll which, in its turn, is correlated with the plant's apparent dependence for all its nutritional requirements on the fungus ensheathing its roots.

On the basis of the available evidence, it has been concluded that *Pterospora* is not a "root parasite" or a "saprophyte" as commonly stated, but is parasitic on the root fungus.

Microfilm \$2.00; Xerox \$3.00. 51 pages.

# STUDIES ON PHYSIOLOGY OF ISOLATED PINE ROOTS AND ROOT CALLUS CULTURES

(L. C. Card No. Mic 58-2726)

Robert L. Barnes, Ph.D.  
Duke University, 1958

Supervisor: Aubrey W. Naylor

Isolated roots of pond, sand, longleaf, slash, and loblolly pines were grown in sterile culture. Intensive studies of nutrition and metabolism were made with pond pine, and to a lesser extent with sand pine roots.

It was found that pond pine roots grew equally well on either White's or Slankis' mineral media. Glycine, an organic supplement in White's medium, inhibited growth severely. Evidence was obtained which indicated that serine, presumably formed from the large amounts of glycine in the medium, caused the inhibition.

Pond pine roots maintained a slow but continuous growth in a medium containing no vitamins, but the growth rate and general vigor were improved by adding pyridoxine and nicotinic acid to the medium. The addition of thiamine to the basic medium did not improve growth. The synthesis of thiamine by isolated roots was demonstrated, and an inhibition of growth resulted from the addition of excessive amounts of thiamine to the medium. Thiamine, pyridoxine, and p-aminobenzoic acid metabolism were investigated further by using specific antimetabolites. Several other vitamins were tested but did not improve growth.

Several auxins and other growth-regulating compounds were tested. Most of these compounds affected the growth rate and also caused changes in the normal branching habit of the roots. It was also found that several vitamins and amino acids stimulated the dichotomous branching of isolated roots.

The use of respiratory inhibitors aided in elucidating some of the metabolic pathways in pine roots. Inhibitions of growth were obtained with dinitrophenol, fluoride, arsenate, arsenite, and iodoacetate.

Amino acid metabolism was studied by adding inhibitors, antimetabolites, or amino acids to the medium and observing changes in the patterns of free amino acids in the treated roots. Changes in free amino acids were noted as a result of practically every treatment. Canavanine, tryptazan, and B-2-thienylalanine inhibited root growth severely. The amino acid changes associated with canavanine inhibition were quite distinct, and were investigated in some detail. A few amino acids (arginine, citrulline, ornithine, proline) appeared to stimulate growth slightly; however, many amino acids appeared to be inhibitory. Some evidence was obtained for the existence of the Krebs-Henseleit urea cycle in pine roots.

Tissue cultures of sand and pond pines were established from proliferations of callus tissue on isolated roots. The cultures were maintained successfully on Heller's nutrient agar. Respiration pathways of sand pine tissue cultures were studied by measuring gas exchanges in the presence of certain respiratory poisons in the Warburg apparatus. Cyanide, iodoacetate, and fluoride inhibited oxygen uptake by callus tissue. Enzyme assays revealed the presence of polyphenoloxidase, peroxidase,

and catalase systems in the tissue, but cytochrome oxidase activity was not demonstrated.

Changes in the free amino acids in sand pine tissue cultures, as the result of additions of antimetabolites and inhibitors, were not as pronounced as in isolated roots.

Long-time feeding of several radioactive compounds showed that the major metabolic pathways in sand pine tissue cultures were apparently similar to those in other higher plants.

The non-photosynthetic fixation of radioactive carbon dioxide was followed and found to occur mainly by addition to pyruvic acid to form malic acid.

Microfilm \$2.25; Xerox \$8.00. 171 pages.

#### THE GENUS *MICROASCUS*

(L. C. Card No. Mic 58-2985)

George Lawrence Barron, Ph.D.  
Iowa State College, 1958

Supervisor: Joseph Gilman

A taxonomic treatment of the genus *Microascus* Zukal is presented with a discussion of the morphology, development, conidial relations, occurrence, and distribution. Twenty-two species and one variety are recognized; one species is excluded. Two new species and two new combinations are proposed. Conidial stages are described for both new species and for two species not previously connected to a conidial form.

Microfilm \$2.00; Xerox \$4.80. 94 pages.

#### NATURE OF RESISTANCE TO PENETRATION AND INFECTION OF *USTILAGO HORDEI* (PERS.) LAGERH. IN SEEDLINGS OF FOUR HULL-LESS SPRING BARLEY VARIETIES

(L. C. Card No. Mic 58-2319)

Parul Chatterjee, Ph.D.  
Michigan State University, 1956

An investigation of the nature or resistance to penetration by *Ustilago hordei* (Pers.) Lagerh. on four hull-less spring barley varieties was made. Seedlings were inoculated with *U. hordei* race 6 and an Alaskan isolate, fixed and sectioned two to four days after inoculations. Prepared slides were observed for the penetration and development of the pathogen and for the possible anatomical barriers produced by the host. The nature of the host response to artificial wounding in the coleoptile of resistant and susceptible varieties was also studied. Differences between the anatomical changes of the coleoptile attacked by the pathogen and the coleoptile wounded artificially were noted.

Spore germination and penetration of the host by the pathogens was similar on all resistant and susceptible varieties. Some anatomical changes developed in the resistant varieties after penetration. A sheath formed in the

epidermal cells of the resistant varieties around the penetrating hyphae which prevented the further penetration of the hyphae into the deeper tissue of the coleoptiles. Collapsed zones were observed very frequently in both resistant and susceptible varieties where there was a heavy inoculum on the surface of the coleoptiles. The size of the collapsed areas increased with an increase in the amount of inoculum on the surface of the coleoptiles. Penetration of the cells by the pathogen in or near the collapsed areas was not always seen in the development of these necrotic areas. In some cases the hyphal growth was retarded in the host without any visible sign of the anatomical changes in the nature of the cytoplasm of the host cells. In these cases the fungal hyphae decreased in diameter and finally ceased to grow.

A very specific reaction was found in all varieties in response to artificial wounding. No sheath formation was observed in this case. Suberin was revealed by microchemical test in the dark stained areas produced by wounding, but it was absent in the necrotic areas produced by hyphal penetration. Microchemical tests revealed cellulose in the sheath-like structures.

The effect of several amino acids on the penetration and growth of the hyphae of race A in the coleoptiles of resistant varieties was studied in seedlings grown on mineral nutrient agar, to which the respective amino acids were added separately. Four of the ten amino acids tried aided the fungus in establishing itself in the tissues of the resistant host. However, amino acid treatments did not change the host-pathogen relationship for the susceptible variety.

Microfilm \$2.00; Xerox \$3.00. 35 pages.

#### THE FLORA OF CLINTON, JACKSON, AND JONES COUNTIES, IOWA

(L. C. Card No. Mic 58-2954)

Tom S. Cooperrider, Ph.D.  
State University of Iowa, 1958

Chairman: Associate Professor Robert F. Thorne

This dissertation is a report on the vascular plant flora of Clinton, Jackson and Jones Counties, Iowa. In preparing this report, approximately 1200 specimens were examined from the herbaria of the State University of Iowa, Iowa State College, and the Davenport Public Museum. The author made and identified 4200 numbered collections which proved to contain 943 species. The author's collections were identified and the herbarium specimens of others were checked with the aid of regional manuals and other appropriate literature, and all were checked against identified specimens in the Herbarium of the State University of Iowa.

The dissertation contains a discussion of the previous collecting in the area, the literature on its flora, the location and extent of the area, its geological history, its topography, drainage, soils and climate, and a discussion of the relationship between physical geography and distribution of some plant species and communities within the area. The well-defined plant communities are described and their component species listed. An annotated catalogue of the species of vascular plants is presented which gives

the name, habitat(s), and relative frequency of each species as well as complete collection data for rare species and partial data for all other species. An attempt is made to account for all names applicable to these species that are used by Fernald in *Gray's Manual of Botany* (1950) and by Gleason in the *New Britton and Brown Illustrated Flora* (1952). In instances where these two differ or where some other work is followed, the names not used are listed as synonyms. Apparent hybrids and atypical specimens are noted, as are difficulties in delimitation of certain species.

These eight species, collected by the author, are believed to be additions to the known flora of Iowa: *Carex plantaginea* Lam., *Carex retroflexa* Muhl., *Coreopsis grandiflora* Hogg, *Helenium amarum* H. Rock, *Hudsonia tomentosa* Nutt., *Krigia virginica* (L.) Willd., *Silphium terebinthinaceum* Jacq., and *Veronica officinalis* L.

A summary of the flora is given below:

A. Components of the flora:

	Species		Genera
	Native	Naturalized	
Pteridophytes	34	0	22
Conifers	3	0	3
Monocotyledons	217	33	95
Dicotyledons	576	135	324
Total	830	168	444

B. Total number of families represented: 117.

C. Total number of species: 998.

Microfilm \$4.45; Xerox \$15.00. 348 pages.

# BIOLOGY OF PUCCINIA STAKMANII

(L. C. Card No. Mic 58-2993)

Paul Calvin Duffield, Ph.D.  
Iowa State College, 1958

Supervisor: Joseph C. Gilman

Cotton rust occurred in epiphytotic proportions in the Yaqui Valley of Sonora, Mexico during the summer of 1956. Cotton as an important crop for this region dates back to 1949; since that time it has become the crop of greatest economic importance. The sudden appearance of rust caused considerable alarm, and spurred authorities to ask for investigations relative to the disease. The study reported here was undertaken as a result.

This disease of cotton, caused by *Puccinia stakmanii* Presley, was observed and studied in the field during the summers of 1956 and 1957. Natural infection of cotton in 1956 caused heavy crop losses in a zone bordering the desert foothills (losses were estimated to be as high as 85%). The degree of infection gradually diminished from the border area until only trace amounts occurred eight to nine miles inside the boundary of the valley. This pattern of infection was related to the distribution of the telial hosts which were with few exceptions restricted to the foothills.

*Bouteloua aristidoides* (H. B. K.) Griseb. and *B. barbata* Lag. were the two principal telial hosts; *Cathestecum erectum* Vasey and Hack. was a minor host.

Disease development following infection was observed to be influenced by environmental conditions. High temperatures and a dry atmosphere favored maximum development. Artificially induced infections in the summer of 1957 caused yield reductions of 40%; natural infections of similar intensity in the summer of 1956 were estimated to have caused much heavier losses. In the latter case the two week period following infection was completely dry, in the former case afternoon showers occurred frequently during the two weeks following infection.

Representatives of fourteen species of *Gossypium* were tested for susceptibility to *P. stakmanii*: *Gossypium hirsutum* Linn., *G. barbadense* Linn. and *G. klotzschianum* Anders. were highly susceptible; *G. aridum* Skov., *G. davidsonii* Kell., *G. armourianum* Kearns. and *G. stocksii* M. Mast. were susceptible; and *G. arboreum* Linn., *G. herbaceum* Linn., *G. raimondii* Ulbrich., *G. gossypoides* Standl., *G. anomalum* Wawra et Peyr. and *G. thurberi* Tod. were resistant.

Infection of the cotton leaf by basidiospores was observed to be by direct penetration of the epidermal cells. Twelve hours incubation in a moist chamber after inoculation promoted infection. Pycnia appeared 5 to 9 days after infection depending on temperatures.

Infection of the grass leaf by urediospores and aeciospores was observed to take place through the stomatal openings. Appearance of pustules varied from 12 to 14 days after inoculation on highly susceptible *Bouteloua* species, but no sooner than 16 days on *Cathestecum erectum*. Both urediospores and teliospores were produced in the same pustules, but the first were limited in number and soon entirely replaced by the latter.

Only a few teliospores from four week old pustules would germinate; the percentage germination increased until the sorus was six months old. The optimum temperature for teliospore germination was approximately 25°C.; germination was inhibited at 20°C. and at 35°C. Basidiospores were only discharged after 24 hours wetting of the teliospores. Telial material kept in a completely saturated atmosphere discharged basidiospores for approximately five days.

Microfilm \$2.00; Xerox \$4.60. 87 pages.

# A MONOGRAPH OF THE GENUS TILLETIA

(L. C. Card No. Mic 58-3037)

Ruben Duran, Ph.D.  
State College of Washington, 1958

An intensive study involving critical microscopic and macroscopic examination of thousands of specimens, involving virtually all species ascribed to *Tilletia* since 1847, solicited from the principal herbaria of the world has indicated that, collectively, the observed diversity of morphologic patterns of mature spores (e.g., size, width and depth of areolae, size and shape of the exospore ornamentations), spore mass color, sporulation loci, sterile cell morphology, host symptomatology, sheath characters, etc., affords a practical means of species delimitation in the genus.

Because many of the specimens included in the study, as well as specimens deposited in herbaria throughout the world, are probably non-viable, and because methods and information on the germination of many species of *Tilletia* are still unknown, germination studies have had limited application in the taxonomy of *Tilletia*, other than providing an additional means of assigning species to the genus. Since spore germination will probably continue to have limited application in the taxonomy of *Tilletia*, especially in species delimitation, a practical method of species delimitation based on spore morphology is proposed as a result of a thorough study of the sum morphologic characters available in *Tilletia*. Thorough familiarity of morphology in *Tilletia*, made possible by studying several thousand specimens microscopically, has revealed an abundance of morphologic characters suitable for taxonomic purposes.

The extensive nature of the study, i.e., the large number of collections included, demanded a special technique for characterizing the spore morphology of each collection. Each was assigned a numerical formula depicting spore morphology somewhat similar to the method proposed for characterizing smut fungi by Ainsworth (Trans. Brit. Mycol. Soc. 25: 141-147). By transferring the assigned formulae of all collections onto L.B.M. punch cards, and subsequently sorting those with similar formulae with the aid of an L.B.M. sorting machine, it was possible to cope successfully with an enormous amount of spore morphology data. Furthermore, the great interspecific as well as intraspecific variation in *Tilletia* became obvious during the progress of the investigation. This morphologic variation requires broader, as well as more practical, limits for species delimitation than expressed by most workers heretofore. In addition, the adoption of this philosophy would discourage the establishment of nominal species based on minor morphologic differences attributable to what the author considers "normal" variation. This variation has required amended and/or amplified descriptions of virtually all valid species included in this work.

Many *Tilletia* species described since 1847 are relegated to synonymy under the oldest valid name. A number of species removed by other workers from *Tilletia* to *Neovossia* based on minor morphologic characters, are retained in the genus. Several composite species are proposed among the sixty-one recognized in this revision. In establishing species limits, the author has attempted to employ morphologic characters which seemed particularly applicable for determinative purposes. It is suggested that taxonomy in *Tilletia* should be further promoted along practical lines and that collections of *Tilletia* should be readily assignable to suggested morphologic species on the basis of comparative spore morphology, with biological considerations secondary; methods for doing so are discussed. Microfilm \$2.30; Xerox \$8.00. 175 pages.

# STUDIES OF FACTORS AFFECTING FRUIT BODY FORMATION IN *CYATHUS STERCOREUS* (SCHW.) DE TONI

(L. C. Card No. Mic 58-2910)

Ellen Marshall Garnett, Ph.D.  
Indiana University, 1958

This investigation of environmental factors influencing fruiting in cultures of the bird's nest fungus, *Cyathus stercoreus* (Schw.) De Toni, was undertaken in an effort to gain some insight into the physiology of fruit body formation. It is desirable to be able to induce fruiting in connection with problems of genetics and nuclear behavior.

Evidence is presented which indicates that light of wavelengths less than 530 mμ is required for induction of fruiting. Fruit bodies appear to be formed only where light impinges directly on the mycelium. After the fruit body primordia have reached a height of about one mm., further development can occur in the dark. Cultures grown in the dark for 40 days before exposure to continuous light tend to produce smaller, more numerous, and more widely scattered fruit bodies than cultures grown in the dark for only ten days before exposure to light. It is postulated that a precursor accumulates in the hyphae and that exposure to light initiates a photochemical reaction involving this substance. Initiation of fruiting would be a result of the photochemical reaction.

Fruiting was found to occur at 20° C., but not at 10° C. Very poor fruiting was obtained at 30° C. Production of a brown mycelial pigment appeared to be enhanced at high temperatures. A preliminary experiment which indicated that incorporation of indole-3-acetic acid in the medium delays fruiting is described, and the possible relation between this substance, the pigment melanin, and fruiting is briefly discussed.

Several experiments indicated that an increase in respiration rate is associated with fruit body development. A high concentration of atmospheric carbon dioxide was found to reduce fruit body yield; replacement of stale medium with sugar solution was found to increase fruit body yield; and studies of pH changes in the medium during growth and fruiting of cultures indicated that during rapid vegetative growth pH decreased and then remained at a low level until fruit bodies developed. In fruiting cultures the pH of the medium then rose, while in non-fruiting cultures (grown in the dark) the pH remained at a low level.

Fruiting was found to occur on liquid medium as well as on medium solidified with two per cent agar. A defined medium containing asparagine and biotin was also found to support fruiting.

Preliminary work indicated that studies of genetic factors influencing fruiting may be feasible, although a high mortality of single spore germlings isolated from one strain was observed. It is suggested that one or more lethal factors may be present in the parent dikaryon. Dikaryotization between the surviving paired haploid sub-strains appeared to be always unilateral or limited. Haploid sub-strains derived from another dikaryotic strain behaved normally.

Microfilm \$2.00; Xerox \$6.60. 136 pages.

PHYSIOLOGICAL VARIATION IN THE  
STRIPE SMUT OF GRASSES, *USTILAGO STRIIFORMIS*

(L. C. Card No. Mic 58-3042)

Heirehalli Chenniah Govindu, Ph.D.  
State College of Washington, 1958

This study deals with the nutritional requirements, spore germination, cultural characteristics, and pathogenicity of *Ustilago striiformis*, the fungus that causes the stripe smut of grasses. Sixty single teliospore isolates from forty-six collections from thirty-seven species in nineteen genera of grasses were studied.

Nutritional studies indicate that *Ustilago striiformis* does not grow well on synthetic media containing the usual inorganic mineral elements, trace elements and/or growth substances. Potato sucrose agar was superior to any other medium tested in enhancing spore germination and subsequent growth in culture. This standard culture medium is now being made available on a commercial scale as Bacto potato malt agar (dehydrated). It contains infusion from 400 gms. of potatoes, 20 gms. malt extract, 60 gms. sucrose, and 1 gm. peptone per liter. The response of an isolate from *Holcus lanatus* to the various components in the medium indicated that potato infusion plus peptone combinations increased sporidial production. Infusion plus carbohydrates increased mycelial growth and rate but depressed sporidial production. These results indicate that potato infusion supplies a very important component in the nutritional requirements of this isolate.

*Ustilago striiformis* is extremely erratic in teliospore germination. A detailed account is given of the "normal" type versus abnormal and aberrant types of spore germination. It is concluded that this abnormality varies with different races and collections of the same organism, different hosts, the time of the year of collection, and other factors.

Cultural characteristics showed widely divergent cultural types among sixty single teliosporic isolates. These differed in topography, color, consistency, size, and rate of growth of the colonies. Isolates from *Agropyron caninum*, *Agrostis exarata*, *Dactylis glomerata*, *Koeleria cristata*, *Phleum alpinum*, *Poa alpina*, *P. pratensis*, and *Trisetum spicatum* developed teliospores in culture. Attempts to associate specific cultural characteristics with pathogenicity were only partially successful. However, it would appear that there is not necessarily a correlation between cultural characteristics and pathogenicity.

Several methods of inoculation were tried. The best results were obtained when spores were injected into the growing seedlings by a hypodermic needle. Based on cultural characteristics and inoculation studies, the existence of a new variety *Ustilago striiformis* var. *holci* var. nov. has been demonstrated, which is distinct from the previously described varieties *agrostidis*, *dactylidis*, *hordei*, *phlei*, and *poae*. Microfilm \$2.00. Xerox \$4.40. 81 pages.

A REVISION OF THE GENUS *HALIMEDA*

(L. C. Card No. Mic 58-3674)

Llewellyn Williams Hillis, Ph.D.  
University of Michigan, 1958

A detailed treatment of the genus *Halimeda* in the order Siphonales of the green algae is represented. Most of the data have been obtained from herbarium specimens, the examination of these being supplemented by comparisons with fluid-preserved material and by limited field work.

The first part of the work includes a comparative examination of the species recognized, with illustrations of their habit and important histological characteristics. This study indicates that macroscopic features including the appearance, whether flaccid, prostrate or erect, the extent of development of the holdfast, the morphology of the lowermost 1-6 segments or internodes, and the predominating shapes and sizes of the other segments are useful in delimiting species. These external characteristics however, can not be depended upon entirely, since they are subject to environmental influence.

Histological characteristics of taxonomic importance include the diameters of the peripheral utricles, and the degree of their lateral attachment, whether adhering for a considerable distance, barely touching, or laterally free. The appearance of the inner cortical utricles, and the extent of development of the cortex are also definitive. All of these microscopic characteristics however, vary somewhat with the aging of the segment. Nodal anatomy, an additional histological feature, is more useful in delimiting groups of species than individual species. Three main types of nodal medullary filament behavior are recognized: (1) filaments continuing unchanged throughout the node, (2) filaments fusing in small groups, most commonly in twos or threes for a distance of 1.5 or several times the filament length, and (3) all or most of the filaments uniting into a single group for a short distance, with adjacent filaments communicating by thick-walled pores.

As seen from an analysis of the maps plotted from the herbarium data of the specimens examined, the distribution of this genus is mainly tropical, the boundary of this and of the subtropical zones being delimited by the 25° C. and 20° C. isotherms respectively, rather than by degrees of latitude. Only two species, *H. cuneata* and *H. tuna* seem capable of extensive development in subtropical waters. The latter occurs to a limited extent in both the tropical and subtropical zones, whereas *H. cuneata* is apparently restricted to the southern subtropics. The reported range of *H. cuneata* however, is more extensive, because specimens of *H. discoidea* are frequently misidentified as this species. Four major categories of distribution occur, with five species pantropical, seven species of Indo-Pacific distribution; four species apparently restricted to the Pacific, and four species found only in the Atlantic. The disjunct distribution of the five pantropical species, *H. discoidea*, *H. gracilis*, *H. opuntia*, *H. tuna*, and *H. incrassata*, which represent two of the three main types of nodal medullary filament behavior, is of particular interest in the phylogeny of the genus.

In the systematic section, the order of arrangement of the species corresponds to the nodal anatomy, two main groups, the *H. tuna* and *H. incrassata* complexes being thus delimited. As a result of the revision of the taxonomy of the genus, twenty-one species, one variety, and one form

are recognized. The species, *H. orientalis*, is placed in synonymy under *H. micronesica*, whereas *H. cylindracea*, which is considered a distinct species, is removed from synonymy under *H. monile*. The taxon *f. hederacea* of *H. opuntia* is elevated to the rank of variety, and *f. lata* is transferred from *H. gracilis* to *H. lacunalis*. The remaining taxa, consisting of approximately thirty varieties and forms, are relegated to synonymy. In addition, it is shown that in the naming of the species *H. incrassata*, the epithet *incrassata* has priority over that of *tridens*, both being in current usage for this single species.

Microfilm \$2.55; Xerox \$8.80. 194 pages.

#### HISTORICAL DEVELOPMENT AND STRUCTURE OF THE ASPEN, JACK PINE AND OAK VEGETATION TYPES ON SANDY SOILS IN NORTHERN LOWER MICHIGAN

(L. C. Card No. Mic 58-3687)

Paul Dayton Kilburn, Ph.D.  
University of Michigan, 1958

This study of the vegetation of Cheboygan County, Michigan, deals specifically with the following three forest types found on the sandy soils in the region: an aspen type dominated by *Populus grandidentata*, a jack pine type dominated by *Pinus banksiana*, and an oak type dominated by *Quercus rubra* and *Q. alba*.

The specific purpose is threefold: (1) to determine the structure and composition of the above types; (2) to investigate the features determining location of each type; and (3) to describe the course of vegetational development. The general purpose is to determine the role of succession and the continuum in the vegetation.

The investigation was made in four parts. The first describes the development of postglacial vegetation, using the pollen analysis work of others as a basis. The second reconstructs the pre-settlement vegetation from the General Land Office Survey data. The third considers the effect of settlement on the vegetation. The fourth is an analysis of the present vegetation and soils through six one-acre sample plots located in, and 15 soil samples taken from, each of the three types. In addition, a 17-year record from four tenth-acre plots in aspen and jack pine types is considered to show changes in the vegetation.

Postglacial vegetational development began with a period of spruce-fir dominance, followed by a period of pine dominance, and concluded by a deciduous period. The latter period was essentially similar to the pre-settlement period with five vegetation-complexes distributed along the soil moisture gradient as follows: wet organic soils, bog conifers; wet-moist mineral soils, swamp hardwood-conifer admixture; loams, sugar maple-beech-hemlock forests; sandy loams, transition forests; sands, pine woodlands.

The present aspen, jack pine and oak types represent modified pre-settlement pine-hemlock-aspen, pine-oak and jack pine forest types. These forest types were probably differentiated during the postglacial pine period. The present distribution of the present types is controlled primarily by the soil texture. The aspen type is on sands

with finest texture, the oak and jack pine types on sands of coarsest texture.

The understory of the three types is similar. *Pteridium aquilinum* is the plant with the largest frequency and highest coverage in each of the three types, and the 25 most frequent plants are present in all three types. Differences are present, but they are quantitative.

The general conclusions are as follows: (1) the vegetation-complexes, as well as the three sandy soil forest types, are best described as a continuum of stable vegetation whose composition is governed primarily by soil texture and drainage; and (2) the succession to a beech-maple climax forest is not evidenced by the dry land types, nor by pre-settlement vegetation complexes, although succession is illustrated by those types which have been severely modified by man.

Microfilm \$3.60; Xerox \$12.20. 280 pages.

#### FACTORS AFFECTING ABSORPTION AND TRANSLOCATION OF FOLIAR APPLIED PHOSPHORUS

(L. C. Card No. Mic 58-3043)

Harold V. Koontz, Ph.D.  
State College of Washington, 1958

The effects of various factors on the absorption and translocation of foliar-applied  $P^{32}$  in bean plants were determined. The amount of phosphorus translocated from the treated leaf in a twenty-four-hour period increased as the amount applied increased, and it was independent of leaf area treated, except possibly at the highest concentration (30 millimolar), and of the leaf surface treated (upper or lower). More phosphorus was translocated from older (lower) leaves than from younger (upper) leaves (very young leaves did not export phosphorus), and the leaves contributed phosphorus to the root in proportion to their proximity to it. All leaves which exported phosphorus contributed approximately equal amounts to the stem apex. Translocation of applied phosphorus was greatest with  $NaH_2PO_4$  and decreased with the following compounds:  $K_2HPO_4 > K_3PO_4 \approx Na_2HPO_4 \approx NH_4H_2PO_4 \approx (NH_4)_2HPO_4 > H_3PO_4$  (injury)  $> KH_2PO_4 \approx Na_3PO_4$ . The amount of phosphorus translocated from a given compound appeared to be directly related to the drying time of the solution on the leaf. Glycerin increased the phosphorus translocation from applied  $KH_2PO_4$  to the level found for  $NaH_2PO_4$  but reduced the translocation from applied  $K_2HPO_4$ , probably because a complex was formed.

Absorption of applied phosphorus ( $NaH_2PO_4$ ) fell off markedly after about thirty hours, but 60 per cent had been absorbed and 34.5 per cent translocated out of the treated leaflet in ninety-six hours. The amount of phosphorus from the treated leaf that moved downward in the stem was initially greater than the amount moved upward, but after forty-eight hours, accumulation in the upper part exceeded that in the lower.

Surface active agents (nonionic, anionic, and cationic) were ineffective in increasing translocation of applied phosphorus. Microfilm \$2.00; Xerox \$3.00. 40 pages.

PHYTOGEOGRAPHIC STUDY OF THE  
CANARY ISLANDS  
(VOLUMES I AND II)

(L. C. Card No. Mic 58-3698)

Kornelius Lems, Ph.D.  
University of Michigan, 1958

The study in plant geography which is here presented is based upon field work in the Canary Islands during the summers of 1954 and 1956. The work consists of a general part which describes the physical environment and vegetation of the islands, and a second part which concerns itself with distribution patterns and growth forms of shrubby plants.

The first part provides an outline of the climatic types, followed by an account of the geology and soils, which emphasizes that the islands are of pre-Tertiary age, that they have probably been islands continuously since they arose, and that these conditions and the climatic stability make them suitable as refugium to ancient plant forms.

Included in the first part is a detailed description of the vegetation belts of the Canary Islands, based upon field observations in which the methods of the Montpellier school of phytosociology were employed. About 25 communities are described, and illustrated by an appendix containing phytosociologic tables.

The principal object of this account is to provide a basis for the biological and geographic analysis which follows in the second part.

The main problem of the dissertation is then introduced: the evolutionary significance of the endemic species of the Canarian archipelago in relation to the more widespread Mediterranean flora. The methods employed may be outlined as follows: within the quadrats upon which the description of the communities rests, collections were made of all species. Some of these were grown in the Botanical Gardens of the University of Michigan, others were preserved as herbarium material. This material was analyzed as to life form (*sensu* RAUNKIAER), shoot architecture, leaf types and dispersal types.

Some results are:

1. While most endemics are woody, especially chamaephytes, the majority of non-endemic species are perennial herbs, biennials or annuals.
2. Among the woody endemics certain types can be distinguished, some less specialized, others clearly xeromorphic. The most primitive type appears to be the "candelabrum - shrub" or "rosette - shrub."
3. Many non-endemic species have wide-range dispersal mechanisms, many endemics lack specialized dispersal apparatus.

Finally, the species composing the communities were classified according to geographic status. Tables are presented, illustrating the incidence of endemics in the different islands and communities. Local evolution of species is demonstrated in several genera, especially with reference to growth forms.

The conclusion reached in this work is that the "candelabrum-shrub" type represents an ancient form of flowering plant, preserved in the Canary Islands as relic populations. From these forms more compact bushes and lower plants may be derived. This hypothesis is confirmed

by geographic distribution of the species, by progressive xeromorphism, and by ecological role in the vegetation belts of the Canary Islands. Thus the Canary Islands may be said to harbor plant forms ancestral to some of the extremely specialized derivatives in the Mediterranean region. The latter, however, have achieved greater ecological success than their Canarian relatives.

The text is accompanied by a volume of appendices containing floristic lists of the Canary Islands, charts of plant communities with growth form data, and geographic distribution maps of some of the critical species.

Microfilm \$4.70; Xerox \$15.60. 365 pages.

POTATO MERISTEM CULTURE AND  
VIRUS X

(L. C. Card No. Mic 58-3007)

Franklin Edward Manzer, Ph.D.  
Iowa State College, 1958

Supervisor: W. H. Bragonier

Virus X disease, well-known throughout the potato growing regions of the world, can cause yield reductions estimated as high as 75 per cent, depending on virus strain, potato variety, and environmental conditions. This disease is controlled mainly by eradication of diseased tubers from partially infected stocks and by use of immune varieties. Many strains of virus X produce no visible symptoms on potato; therefore specialized methods for detection must be used. Before these methods were available many of the older varieties that are still grown today became universally infected. To obtain increased yields, elimination of virus X from such varieties has been attempted. Meristem culture and malachite green treatment have been used successfully by some workers for this purpose. The present study was undertaken to investigate the effectiveness and practical aspects of these methods and to develop a virus-free clone of the Irish Cobbler potato variety.

Parent meristem apices, subcuttings and re-isolations, with and without malachite green treatment, were cultured on several types of liquid and solid media. Considerable difficulty was experienced in achieving and maintaining satisfactory culture growth. No virus X-free potato plantlets or even plants showing measurable reduction in virus titer were obtained. Consequently meristem culture with malachite green treatment for virus X elimination appears to be extremely limited in practical application and effectiveness.

In other experiments dormant and sprouting Irish Cobbler seedpieces were submerged in a 100 ppm. water solution of thiouracil for varying lengths of time. Considerable seedpiece decay after planting occurred in pieces treated for 24 hours or longer. No virus-free plants resulted from sprouting tubers. Four virus-free plants from dormant tubers, one of which had been treated for only one hour, were obtained. Nine tests for virus X on *Gomphrena globosa* L., conducted over a four-month period, showed no evidence of virus X in these plants. Serological tests also gave negative results. As all four virus-free plants resulted from treating dormant tubers, it was suggested

that dormant tubers or dormancy-breaking treatment contributed to the effectiveness of thiouracil treatment. The ease and effectiveness of the thiouracil treatment justify consideration of this method for routine virus X elimination.

Microfilm \$2.00; Xerox \$3.80. 67 pages.

AN ECOLOGICAL STUDY  
OF THE GRASS BALDS OF THE  
SOUTHERN APPALACHIAN MOUNTAINS

(L. C. Card No. Mic 58-2742)

Alan Francis Mark, Ph.D.  
Duke University, 1958

Supervisor: William D. Billings

An attempt was made to explain the presence of high altitude natural grasslands on well-drained areas, below the climatic treeline, in the predominantly forested southern Appalachian Mountains. These grass balds are confined to a narrow altitudinal band around 5,400 feet, which is the altitude of the relatively abrupt transition between deciduous hardwood forest below and evergreen coniferous forest above. Many balds occupy summits above pure hardwood forest, in the potential altitudinal range of coniferous (spruce-fir) forest. The slow-growing, dwarfed, and misshapen trees of the hardwood forest on the bald margins indicate timberline conditions. Growth rates and form of spruce and fir trees, where present adjacent to or on balds, indicate that the bald environment is within their tolerance ranges.

The soils of balds and adjacent forests are generally similar in physical and chemical properties. Measurements of air lower-air and soil temperatures, precipitation, evaporation, insolation, wind, and soil moisture tensions showed that the bald environments are much more extreme than those within adjacent hardwood and coniferous forests. That one bald is within the tolerance ranges of spruce and fir was demonstrated with seedling transplants.

Despite numerous theories explaining the balds, none are generally accepted, perhaps because of the frequent failure to distinguish between the separate problems of bald origin, maintenance, and extension, and also the lack of experimental verification of theories. Evidence from this study discounts the theorized causal factors of rainfall deficiency, edaphic factors, plant competition, insect damage, exposure to desiccating winds, and Indians clearing the forest.

The probable effect of post-Wisconsin climatic fluctuations on the distribution of the high altitude forests assists in explaining the balds. A xerothermic period restricted coniferous forest to altitudes 300 to 1,000 feet higher than its present lower limits, thus causing: 1. its elimination from many peaks which it could now potentially occupy, and 2. reduction of spruce and fir biotypes on other mountains. Subsequent cooling climate has caused the formation of a "bald-susceptible" zone along the ecotone between hardwood and coniferous forests, and about the potential ecotone on mountains from which coniferous forest was eliminated. Absence of a spruce and fir seed source from these latter areas would have prevented their invasion, while biotype depletion in other areas may have retarded

their invasion into areas of degenerate upper hardwood forest. The balds, then, have probably originated during a post-xerothermic period of cooling climate through agents of forest destruction. Only in the bald-susceptible zone would the rate of tree seedling reestablishment be very slow or lacking, because the tolerance limits of the seedlings, already approached here, are much more closely approached or perhaps exceeded, under the severe environments on treeless areas. Bald maintenance depends on the relative severity of the treeless environment, lack of a spruce and fir seed source in certain areas and possible elimination of lower-margin biotypes in other areas, and grazing and browsing. Bald extension results from destruction of the marginal forest by natural and artificial forces. Tree invasion onto ungrazed balds indicates that balds are barely within the tolerance ranges of certain tree species, and therefore, may eventually become forested. Spruce and fir are invading more rapidly than hardwoods. Therefore, the higher balds without a spruce and fir seed source may persist longer than either the lower balds or those with a spruce and fir seed source.

Microfilm \$4.80; Xerox \$16.20. 376 pages.

VARIATION AND MORPHOLOGY OF  
*PODOPHYLLUM PELTATUM*

(L. C. Card No. Mic 58-3788)

Frank Winstead Martin, Ph.D.  
Washington University, 1958

Chairman: Professor Edgar Anderson

This study is concerned with the analysis and the interpretation of the variation in *Podophyllum peltatum*.

The study of the morphology and anatomy reveals that the aerial vegetative shoot should be considered as a petiole with a peltately-attached leaf. The flowering shoot is interpreted as two aerial vegetative shoots enclosing a flower stalk.

The random appearance of characteristics associated with the Asiatic species of this genus in the American species suggests the derivation of the latter from an ancestral form that was directly or indirectly derived from the former. These characters are as follows: red-colored fruits, pink flowers, inflorescence located above the fork, and 3-foliate shoots.

A precise study of variation of the median lobes of the leaves of *P. peltatum* reveals a significant variation of additional characteristics. These characteristics are combined in order to form a mathematical value by which individual specimens may be designated. This value is referred to as the index value. The plants associated with the highest of the index values resemble the Asiatic species of this genus. A study of the geographic distribution of the index values reveals an association of specific values with discrete physiographic areas. The areas in which the low index predominates are floristically older. This is the evidence for suggesting that an Asiatic ancestral form hybridized with a local form.

The local ancestral form appears to be concentrated on the Ouachita and parts of the Appalachian Mountains. The index values, characterizing plants which closely resemble

Asiatic species, are found in glaciated areas of eastern North America. Microfilm \$2.00; Xerox \$4.80. 92 pages.

**PHYSIOLOGICAL ACTION OF ISOPROPYL  
N-(3-CHLOROPHENYL)CARBAMATE**

(L. C. Card No. Mic 58-3008)

John Arthur Meade, Ph.D.  
Iowa State College, 1958

Supervisor: W. E. Loomis

Weed control, particularly with chemicals, has become an important part of the management of agronomic crops. While cultural methods are still of primary interest, the use of herbicides has become prevalent. Some situations require the use of chemical weed control, but in others it is a matter of economics or convenience. The herbicide, isopropyl N-(3-chlorophenyl)carbamate (CIPC), has been found useful in the control of chickweed, a winter annual, in the hay fields of the Northeastern states and England. It is also used to some extent for control of weedy grasses in row crops.

The first observed action of this herbicide was as a mitotic poison. Mitosis is stopped at the metaphase stage, leading to chromosomal aberrations. The non-chlorinated isopropyl N-phenylcarbamate (IPC) has been found to affect the dehydrogenases of the four carbon acid cycle. Respiration in general was decreased by the use of both IPC and CIPC.

This study was intended to clarify the physiological action of this herbicide. It was found that ryegrass and oats are much more sensitive to CIPC than corn. Among the broad-leaved plants, cucumber is extremely susceptible while soybeans are rather tolerant. Raising the temperature of germination from 20°C to 30°C did not increase the effect of CIPC on root elongation of alfalfa or ladino clover. It appeared that germination of most species was not reduced and in some instances it was increased.

There was no significant effect on respiration of alfalfa leaves vacuum infiltrated with a CIPC solution. A study of the respiration of wheat seeds germinating in contact with CIPC indicated that low concentrations of CIPC may increase respiration and high concentrations decrease it. This is the effect observed with many toxins, which first seem to break down permeability or alter relations between enzymes and substrates, then with increasing concentrations become generally inhibiting.

It was found that treated roots were able to utilize exogenous glucose and sucrose as well as the checks, although acid phosphatase activity of these roots was increased markedly. It would seem possible then that the increased effect of phosphatase activity is on nucleosides. This might explain the effect of CIPC on mitosis.

Microfilm \$2.00; Xerox \$3.00. 50 pages.

**EFFECT OF MINERAL NUTRITION ON  
INVASIVENESS OF PLASMODIOPHORA  
BRASSICAE WOR. AND DEVELOPMENT  
OF CLUBROOT**

(L. C. Card No. Mic 58-3057)

Elmer Thurman Palm, Ph.D.  
Oregon State College, 1958

Major Professor: Roy A. Young

This study was undertaken to investigate some aspects of the effects of mineral nutrition on initial infection of Shogoin turnip plants by *Plasmodiophora brassicae* Wor. and subsequent clubroot development.

Calcium at concentrations up to 40 milligrams per liter of nutrient solution stimulated infection, while concentrations slightly above or below this concentration inhibited infection. Growth of the host was not affected by increasing the concentration of calcium to at least 160 milligrams per liter. Clubroot development was stimulated with increasing concentrations of calcium up to 100 milligrams per liter. The calcium level that was inhibitory to initial infection was affected by the concentration of boron in the nutrient solution. When the boron level was high, calcium was more inhibitory than when the boron level was low or when no boron was added.

Hydrated lime, applied at the rate of 4000 pounds per acre in a field experiment, gave better control than rates of 250 or 1000 pounds per acre. When hydrated lime was applied at the rate of 250 pounds per acre the clubroot disease was stimulated. Quantities of boron up to 50 pounds per acre applied to the soil did not appear to bring about control of clubroot except when hydrated lime was used at the rate of 250 pounds per acre. With this treatment, boron applied at the rate of 50 pounds per acre gave a greater percentage of healthy plants than when no boron was added to the soil.

As low as 2 milligrams of boron per liter of nutrient solution markedly reduced initial infection. With increasing concentrations of boron above 8 milligrams per liter, top growth as measured by the length was progressively reduced. Root growth was only slightly reduced with concentrations of boron up to 64 milligrams per liter.

Both initial infection and clubroot were stimulated with increasing concentrations of potassium. As much as 280 and 300 milligrams of potassium, respectively, did not inhibit initial infection and clubroot development. A greater quantity of potassium was found in the clubs than in the rest of a plant or in a healthy plant. Less potassium was found in the roots of recently infected plants in which no swelling had occurred than in roots of healthy plants. The suggestion was made that potassium is present in greater quantity in the club than in the rest of the plant because the club is an actively growing region of the plant and not because the pathogen is present.

An acid pH range was optimum for both initial infection and subsequent clubroot development.

The effects of beryllium, lithium, cesium, strontium, barium and rubidium on initial infection and plant growth were studied. All of these elements except strontium inhibited infection with *P. brassicae* at very low concentrations. The order of inhibitory activity was as follows: Be > Li > Cs > Ba > Rb > Sr. These elements are not essential nutrients for plant growth but some of them at

least are very toxic to plants and micro-organisms and are present in many agricultural soils. The effect of these elements may be directly on the pathogen rather than on the host parasite relationship.

Microfilm \$2.00; Xerox \$4.40. 82 pages.

**COLLETOTRICHA ASSOCIATED WITH  
LILY BULBS. THEIR PATHOGENICITY  
AND HOST RANGE**

(L. C. Card No. Mic 58-2851)

Edward Kenneth Sobers, Ph.D.  
Louisiana State University, 1958

Supervisor: Professor A. G. Plakidas

In 1950 and 1951, inspectors of the Bureau of Entomology and Plant Quarantine found a *Colletotrichum* sp. associated with lesions on the bulb scales of a number of species of lilies being imported from the Orient. These lesions resembled somewhat those found in black scale disease of Easter lily bulbs. *Colletotrichum* isolates obtained from the imported bulbs could not be differentiated from the black scale fungus, *C. lilii*, on the basis of size, shape, or the color of their conidia. Since the black scale disease had only been found in Bermuda and Louisiana, and had never been reported as occurring on bulbs other than those of the Easter lily, these isolates were subjected to pathogenicity tests on the black scale susceptible Creole Easter lily, in comparison with *C. lilii*.

Sixteen isolates from various bulbs and plant materials were found to be non-pathogenic to the Creole Easter lily during two successive growing seasons. It was also found that these isolates were non-pathogenic to bulbs of the types from which they were originally isolated. In host range studies with *C. lilii* it was found that bulbs of *L. callosum*, *L. candidum* (Cascade and White Elf strains), *L. cernuum*, *L. Davidii* 'Maxwill', *L. formosanum*, *L. Henryi*, *L. japonicum*, *L. regale*, *L. speciosum* var. *album*, and *L. speciosum* var. *rubrum* were not susceptible. However, bulbs of *L. amabile*, *L. dauricum* var. *sanguineum*, *L. martagon* var. *album*, *L. pumilum*, *L. umbellatum*, and the Creole, Croft, Estate, and Georgia varieties of Easter lilies (*L. longiflorum*) were found to be susceptible to the disease. On the case of *L. concolor*, it was found that the fungus could be isolated from the necrotic scale tips of the bulb, although the scales showed no typical black scale lesions.

In an effort to differentiate between pathogenic and non-pathogenic forms of the fungus, critical morphological and growth studies were made. These studies revealed that all isolates could be differentiated from the pathogenic form by growth studies in liquid medium. Morphological differences were found in only four isolates.

Studies with the pathogenic fungus to determine its effect on the growing lily plant indicated no adverse effects on flowering, plant vigor, bulb development, or forcing ability. Bulblet production however, was significantly increased in plants whose bulbs were infected by *C. lilii*. At no time was the fungus observed on any part other than the bulb scales.

Microfilm \$2.00; Xerox \$5.20. 102 pages.

**THE FLORA OF SOUTHCENTRAL IOWA**

(L. C. Card No. Mic 58-2983)

Theodore Van Bruggen, Ph.D.  
State University of Iowa, 1958

Chairman: Professor R. F. Thorne

This paper represents a systematic enumeration of the native and adventive vascular plants known to grow spontaneously in the southcentral part of Iowa. The counties comprising this area are: Clarks, Dallas, Decatur, Jasper, Lucas, Marion, Polk, Warren, and Wayne.

For the preparation of this flora the author has collected, identified, and labelled over 8,000 plant specimens from this area. A smaller number of herbarium specimens, previously collected in southcentral Iowa, were carefully checked and annotated. Herbaria which contributed these specimens are: State University of Iowa, Iowa City, Iowa; Iowa State College, Ames, Iowa; and Grinnell College, Grinnell, Iowa.

Available appropriate literature has been utilized in the application of correct names and in the delimitation of species. Commonly encountered synonyms are included. Special attention is given to taxa which show evidence of hybridization or which in some other way are atypical.

A map has been prepared for each species showing locations where specimens have been collected or observed. Species which have been reported in the literature but for which no voucher specimen has been seen are not considered part of the flora but are dealt with in a separate section of the paper.

The number of species currently known for southcentral Iowa is 1024. Of this number 803 are considered indigenous. A total of 124 families are represented by the flora. Microfilm \$6.50; Xerox \$22.80. 509 pages.

**NEMATODES ASSOCIATED WITH WHITE  
CLOVER (*TRIFOLIUM REPENS* L.)  
IN LOUISIANA**

(L. C. Card No. Mic 58-2858)

Estle Jacob Wehunt, Ph.D.  
Louisiana State University, 1958

Supervisor: Professor John P. Hollis

The decline of stands of white clover in Louisiana and the occurrence of several suspected plant parasitic nematodes in association with this crop were observations leading to this study. It was desired to determine the plant nematodes which might be implicated in this difficulty and their importance to the farmers who grow white clover in Louisiana.

A survey, consisting of over 200 samples, was made of white clover fields in 55 parishes in Louisiana. Of the total samples, 122 consisted of both plant and soil for detection of root-knot and cyst-nematodes as well as free-living plant nematodes. The remaining samples were of soil for detection of free-living plant nematodes only.

Root-knot nematodes were found in 14.6 per cent of the

samples and were comprised of three species of the genus Meloidogyne. The clover cyst-nematode, Heterodera trifolii was found in 7.4 per cent of the samples. Species of both genera were largely confined to the Red and Mississippi River floodplains.

The survey revealed the presence of 12 genera of free-living plant nematodes consisting of over 15 species associated with white clover in Louisiana. Four genera were present in over 70 per cent of the samples while the remaining genera were distributed in less than 35 per cent of the samples.

Greenhouse studies demonstrated that the association of a nematode with a plant is not adequate proof of parasitism of the nematode. Only six species of the free-living plant nematodes were shown to be parasitic on white clover. All species of root-knot nematodes and the cyst-nematodes found in this survey were parasites of white clover. Further studies in the greenhouse demonstrated that certain species which exhibited parasitic relationships with white clover were capable of causing damage to the plant.

Field experiment were conducted at three locations in 1955 and at four locations in 1956. Chemicals with differential activities against microorganisms were used to determine the growth of white clover in the absence of nematodes, in the absence of fungi and in the absence of both groups of microorganisms. Differences in plant responses were not obtained by control of fungi. Control of nematodes resulted in better plant growth as did the control of both nematodes and fungi. However, plant responses resulting from the control of both nematodes and fungi failed to differ significantly from those resulting from the control of nematodes alone. These results indicated that nematodes caused damage to white clover under field conditions and that they may be important factors in the decline of stands of the crop in Louisiana.

It is estimated, from the results of this study, that plant parasitic nematodes are costing Louisiana white clover growers \$1,061,080.00 per year by decreasing the yield of forage alone.

Microfilm \$2.00; Xerox \$4.00. 74 pages.

## CHEMISTRY

### CHEMISTRY, GENERAL

#### I. THE EFFECTS OF AGING OF REAGENT SOLUTIONS ON THE PARTICLE SIZE OF PRECIPITATES AND II. ELECTRODES CONSISTING OF MEMBRANES OF PRECIPITATES

(L. C. Card No. Mic 58-2899)

Robert Frederick Babcock, Ph.D.  
Indiana University, 1958

Aging of some reagent solutions before precipitation affects the particle size of the precipitate. Barium sulfate was precipitated with barium chloride solutions which had been allowed to age for varying periods of time. Particle sizes of the precipitates were measured microscopically and turbidimetrically and found to be a function of the age of the barium chloride solution. Typically the average particle size varied from about 5 microns with a fresh barium chloride solution to 15-25 microns with a solution aged twenty four hours or longer. After much longer aging periods the size again decreased to that obtained with a fresh solution. Mixtures of fresh and aged barium chloride solutions produced small particles. Solutions prepared from large barium chloride crystals produced large particles when fresh and exhibited only a slight aging effect. The age of the sodium sulfate solution did not affect the barium sulfate particle size.

When barium chloride solutions were aged in contact with adsorbing materials, the aging effect was enhanced. Using dilute solutions, the induction and growth periods in the precipitation of barium sulfate were studied turbidimetrically. The induction period lengthened with decreasing reagent concentration and increasing aging time of the barium chloride solution. Fresh and aged barium chloride solutions containing radioactive barium were filtered through porcelain and filter paper. The amount of barium removed during filtration was not a function of the age of the solution. The aging phenomenon is apparently due to nuclei in a fresh barium chloride solution which are adsorbed and/or dissolved on aging. These nuclei do not appear to be undissolved barium chloride particles; however, their nature is still not clear. Aging effects were noted with some other solutions and precipitates.

Membrane electrodes were prepared of barium sulfate with paraffin as a binder, and their selectivity and sensitivity were determined. The potentials obtained with these electrodes increased with increasing barium chloride concentration and decreased with increasing sodium sulfate concentration. It appears that the potentials result from selective adsorption of ions by the membrane, with oppositely charged ions being transported through the membrane according to their relative ionic mobilities. This view was supported by results obtained with several electrolytes, including some having neither ion in common with those of the membrane. Potentials obtained were

generally less than those predicted from the Nernst equation.

Diffusion experiments with the barium sulfate-paraffin membranes were carried out by radioactive tracer and conductance methods. Results with barium chloride solutions indicated no permeation through the membrane of barium ions in the time required to attain a potential equilibrium. Potentiometric titrations of sulfate with these membranes were of limited success because the potential depended on all the ions in solution, and because equilibrium times were long. Titrations of sulfuric acid with barium hydroxide gave sharp end points. A few experiments were conducted to determine the potential response of membranes containing precipitates of silver chloride and barium chromate.

Microfilm \$2.00; Xerox \$6.40. 132 pages.

#### IONIUM-URANIUM RATIOS IN MARINE DEPOSITED CALCIUM CARBONATES AND RELATED MATERIALS

(L. C. Card No. Mic 58-3790)

William Malcolm Sackett, Ph.D.  
Washington University, 1958

Chairman: Professor H. A. Potratz

The disequilibria in the three naturally occurring radioactive families in ocean water, marine and non-marine calcium carbonates and fossil bones have been investigated.  $\text{Th}^{230}$ - $\text{U}^{238}$  ratios have been determined with a view of ascertaining the conditions under which the ratios may serve as a measure of geologic age. The results and the conclusions are as follows:

In a deep and surface sample of Pacific Ocean water, the  $\text{Th}^{230}$  content was less than 5% and 1% respectively, of the amount required for equilibrium with the  $\text{U}^{238}$  present. The  $\text{Th}^{227}$  concentration was also less than the equilibrium amount with respect to the  $\text{U}^{235}$ . These results show that not only  $\text{Th}^{230}$  but apparently also  $\text{Pa}^{231}$  and/or  $\text{Ac}^{227}$  are precipitated with the sediments. The radium content is far in excess of the amount which can be supported by the  $\text{Th}^{230}$ .

The uranium contents of marine carbonates range from 0.1 to 5ppm, the highest are associated with the aragonite structure. Calcitic materials are almost invariably low in uranium. All newly deposited marine calcium carbonates are, however, virtually free of  $\text{Th}^{230}$ .

If a calcium carbonate deposit is formed which (1) contains a measurable amount of uranium (2) has very much less than the equilibrium amount of  $\text{Th}^{230}$  and (3) does not gain or lose uranium or lose the  $\text{Th}^{230}$  which grows into the calcium carbonate from the radioactive decay of uranium, then the time at which the calcium carbonate was

deposited can be determined from the  $\text{Th}^{230}\text{-U}^{238}$  ratio within the experimental error of the analyses for materials from 1000 to 300,000 years old.

In all analyzed marine carbonates, conditions (1) and (2) appear to be satisfied. In some carbonates, the third condition has apparently been violated.  $\text{C}^{14}$  ages are generally lower than the  $\text{Th}^{230}\text{-U}^{238}$  ages. The disagreement, in some cases, is taken as an indication that transformation of aragonite to calcite has occurred. This transformation is assumed to take place through a solution-redeposition process in which  $\text{C}^{14}$  would be gained and uranium would be lost. Discrepancies between  $\text{C}^{14}$  and  $\text{Th}^{230}\text{-U}^{238}$  ages may also arise in samples of older limestone which have been contaminated with younger material. This would increase the  $\text{C}^{14}$  content and decrease the  $\text{Th}^{230}\text{-U}^{238}$  ratio in the older limestone. It is shown that the apparent change in age which results from such contamination would, in general, be greater for  $\text{C}^{14}$  than for  $\text{Th}^{230}\text{-U}^{238}$  determined ages.

Assuming that the vertical growth of coral atolls has taken place during high water stages of interglacial times, the apparent ages obtained from  $\text{Th}^{230}\text{-U}^{238}$  ratios for samples obtained in drilling on Parry Island, Eniwetok Atoll give a Pleistocene chronology which compares favorably with Emiliani's recent estimates.

Uranium and isotopic thorium determinations have been made on non-marine calcium carbonates (tufas) from the Lahontan and Bonneville Lake basins. Currently forming tufa contains  $\text{Th}^{230}$ . Since the  $\text{Th}^{230}$  content at the time of deposition of older tufas is unknown, ages cannot be calculated directly from  $\text{Th}^{230}\text{-U}^{238}$  ratios.

Some fossil bones have been analyzed for  $\text{Th}^{230}$  and uranium. The uranium content ranged from 7 to 1600 ppm, indicating uptake from ground waters. Since the rate of uranium uptake by the bones is unknown, reliable ages can probably not be calculated from the  $\text{Th}^{230}\text{-U}^{238}$  ratios in these materials.

Two additional radiochemical procedures for dating recent marine deposited calcium carbonates are suggested.

Microfilm \$2.00; Xerox \$5.20. 106 pages.

## CHEMISTRY, BIOLOGICAL

### THE BIOCHEMISTRY OF MELANIN FORMATION IN SHRIMP

(L. C. Card No. Mic 58-2836)

Milton Edward Bailey, Ph.D.  
Louisiana State University, 1958

Supervisor: Dr. Ernest A. Fieger

Physical and chemical properties of the enzyme(s) which cause black spots in shrimp were studied. Several of these properties were similar to those of phenol oxidases (phenolases) from plant and animal sources: the shrimp enzyme system catalyzed the oxidation of both mono- and o-dihydric phenols; shrimp catecholase required copper for its activity; substances known to inhibit phenolase activity also inhibited activity of shrimp catechol-

ase, these included copper and phenol binding agents, reducing agents and carboxylic acids; the shrimp enzyme(s) appeared to be a water-soluble globulin and could be concentrated by methods similar to those used in the purification of mushroom catecholase; catecholase activity in crude preparations from shrimp was slightly increased by heating at 50°C. for 1 and 2 minutes and energy of activation values compared favorably with those obtained for phenolases from other sources.

Chromatographic and spectrophotometric methods were used to identify phenolic compounds associated with melanin formation. L-tyrosine, L-dihydroxyphenylalanine (dopa) and 2-carboxy-2, 3-dihydroindole-5, 6-quinone (dopachrome) were identified in shrimp samples and the various melanogenic phases identified with "dopa melanin" formation observed during the darkening of these samples. Data is presented which suggested that shrimp phenolase is stereospecific for the catalysis of L-dopa. Dialyzates of shrimp blood and press juice continued to darken even at low temperatures (3°C.) suggesting that proteins containing phenolic groups may also act as substrates for shrimp phenolase.

Blood fractions from *Peneaus setiferus* and *Peneaus aztecus* exhibited high o-dihydric phenolase activities. The "sediment" obtained by centrifuging blood from these shrimp species contained a more highly active o-dihydric phenolase than did "plasma" or "serum" from the same blood. Leucocytes in this blood may contain active phenolase(s) released when shrimp blood is exposed to air. Other evidence presented favors the existence of highly active phenolase(s) in shrimp blood cells. Data was obtained which indicated that hemocyanin could catalyze the oxidation of pyrocatechol, and consequently may be involved in black spot formation in shrimp.

Michaelis constants were calculated for shrimp catecholase and DL-dopa oxidase.

Microfilm \$2.00; Xerox \$5.20. 102 pages.

### AN INVESTIGATION OF THE NATURE OF CARNOSINE IN MUSCLE

(L. C. Card No. Mic 58-2889)

Fred G. Bock, Ph.D.  
The University of Buffalo, 1958

This study was prompted by suggestions that carnosine and anserine might not exist in the free state in living muscle. The experimental approach was developed along three lines, attempts to isolate carnosine from fresh muscle using mild methods, measurement of titration curves of carnosine in the presence of metal ions, and comparison of rates of diffusion of carnosine from fresh muscle homogenates with the rates from pure solutions.

The isolation procedure made use of the fact that carnosine flavanate separates from solution slowly, whereas, most flavanates crystallize rapidly. Crude carnosine flavanate could be isolated from fresh horse muscle within 5½ hours of the death of the animal. During the isolation, the pH remained above 3, and periods of heating were reduced to a minimum.

The recovery of crude carnosine flavanate averaged 49% from either fresh horse muscle or from horse muscle

stored in the frozen state for periods of several months. Crude carnosine flavianate could be recrystallized with excellent recovery to provide pure carnosine flavianate.

The titration curve of carnosine in the presence of cupric ions demonstrated the binding of this metal with carnosine. The cupric ion displaced hydrogen ions from the dipeptide molecule, reducing the pH of the solution. Since the concentration of cupric ions was reduced, cupric hydroxide did not precipitate at the pH expected for pure  $\text{CuSO}_4$ . Measurement of the titration curves of carnosine in the presence of the following ions failed to demonstrate complex formation:  $\text{Li}^+$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Rb}^+$ ,  $\text{Ca}^{++}$ , and  $\text{Mg}^{++}$ . While complete titration curves were not obtained in the presence of  $\text{Fe}^{+++}$ ,  $\text{Fe}^{++}$ , and  $\text{Mn}^{++}$ , their hydroxides precipitated from solution in the presence of carnosine at the pH expected. Accordingly, it appeared likely that, in muscle, the bulk of carnosine is not bound to metal ions by simple chelation.

The rate of dialysis of carnosine from pure solutions was studied under various circumstances. Within the limits of the experiment, the rate of dialysis was independent of variations in volume, carnosine concentration, ionic strength, or pH of the test solution. The rate of dialysis was not affected by the presence of human serum albumin in the test solution, nor was carnosine bound by this protein. On the other hand, dialysis of carnosine was temperature dependent.

Fresh frog muscle homogenates were dialysed at a temperature of  $3^\circ\text{C}$ . Four groups were employed in the study. The first consisted of normal animals, the second group was anesthetized with  $\text{MgSO}_4$  prior to sacrifice, the third was paralyzed with curare, and the fourth group was treated with NaF. The dialysis rate of carnosine from each of the groups was similar to that from pure carnosine solutions.

While the results are not sufficient to prove that native carnosine exists in the free state, they suggest limits upon the nature of a carnosine complex, should one exist. The data would be consistent with one of the following circumstances: 1) carnosine exists in the free state in living muscle, 2) while the bulk of muscle carnosine is "free," a small amount (less than 10%) is present in a "bound" form, 3) the bulk of muscle carnosine is in the form of a very unstable complex molecule which decomposes within thirty minutes at pH 7 and  $3^\circ\text{C}$ ., and 4) the bulk of the carnosine is in the form of a slightly stable complex with molecular size comparable to that of free carnosine, and which decomposes under the conditions of isolation employed.

Microfilm \$2.00; Xerox \$6.00. 123 pages.

#### KINETICS OF AMMONIA METABOLISM IN VIVO

(L. C. Card No. Mic 58-2730)

George D. Duda, Ph.D.  
Duke University, 1958

Supervisor: Philip Handler

$\text{N}^{15}\text{H}_3$ , D- and L-leucine- $\text{N}^{15}$  and glutamine amide- $\text{N}^{15}$  were given by tail vein to adult rats. Groups of rats were sacrificed at intervals; free urea, glutamine, glutamate,

aspartate, alanine and glycine were isolated from their livers and their  $\text{N}^{15}$  content determined. The  $\text{N}^{15}$  of whole body urea and glutamine amide-N were also measured. At low  $\text{NH}_3$  dosage, glutamine synthesis proceeded 7-10 times as rapidly as that of urea. From the earliest time the isotope content of glutamine amide-N considerably exceeded that of glutamate. Thus, glutamine synthesis is the major factor in maintaining the low steady state concentration of  $\text{NH}_3$ .

A plot of glutamine synthesis vs.  $\text{NH}_3$  dosage yields a characteristic Michaelis-Menten plot. Urea synthesis, in contrast, proceeded at a rate of 8.6 per cent of the administered dose in twenty minutes over a 50 fold dosage range. Turnover of glutamine amide-N, was found to proceed at a rate commensurate with the requirements for urea synthesis by rats on high protein diets. The fate of the N of D-leucine was similar to that of  $\text{NH}_3$ , albeit somewhat slower; this is compatible with oxidation to  $\text{NH}_3$  and the  $\alpha$ -keto acid by D-amino acid oxidase. After L-leucine administration, isotope appeared in glutamic acid well before glutamine or urea, thus providing *in vivo* evidence that the initial step in L-amino acid metabolism is transamination.  $\text{N}^{15}$  appeared in glycine in significant amounts only after L-leucine administration. Balance studies showed that twenty minutes after the administration of  $\text{N}^{15}\text{H}_3$  all the isotope could be recovered as urea, glutamine or unreacted ammonia. Microfilm \$2.00; Xerox \$3.00. 54 pages.

#### Previous Publication

Brown, R. H., Duda, G. D., Korkes, S., and Handler, P.,  
*Arch. Biochem. Biophys.*, 66, 301 (1956)  
Duda, G. D., and Handler, P., *J. Biol. Chem.*, in press

#### METABOLIC FATE OF HOMOLOGOUS AND HETEROLOGOUS SERUM PROTEINS

(L. C. Card No. Mic 58-2909)

Sidney Fleischer, Ph.D.  
Indiana University, 1958

Rabbit or guinea pig serum albumins or globulins, biosynthetically labelled with  $\text{S}^{35}$ -amino acids, were injected into rabbits. The activity of the serum albumins and globulins of the recipients was determined over a period of 9 days following injection. No special conversion of homologous serum albumins to globulins was observed. Experiments of other workers which seem to show such a conversion can best be explained on the basis of breakdown of the injected biosynthetically labelled protein followed by reutilization of the breakdown products for the formation of new proteins. The extent of the reutilization into newly-formed serum proteins when  $\text{S}^{35}$ -rabbit serum albumins or globulins are injected into rabbits was evaluated and found to be low. The error in the half-life of transfused homologous  $\text{S}^{35}$ -serum proteins in the rabbit as a result of such reutilization is small within the 9 days studied.

The activity in the serum proteins due to dithio-bond

formation after i.p. injection of  $S^{35}$ -yeast protein hydrolysate into a rabbit is very large immediately after injection and does not become negligible until about 30 hours after injection.

When rabbits or rats are injected i.v. with an enzymatic digest of lightly iodinated serum albumins, negligible activity was found in the serum and organ proteins of the recipients. It seems likely that studies using  $I^{131}$ -proteins are not complicated by reutilization. The hair represents an exception.  $I^{131}$  activity is incorporated into the hair of rats after the injection of either  $I^{131}$ -proteins, their enzymatic digests, or radio-iodide.

The fate of homologous and heterologous  $S^{35}$ -serum albumins, labelled in addition by trace iodination with  $I^{131}$ , was studied in the rabbit and rat in an effort to learn more about the mechanism by means of which the circulating injected proteins are utilized in the formation of tissue and serum proteins. As a working hypothesis it is assumed that a change in the  $S^{35}/I^{131}$  ratio from that of the injected material,  $RIR(S/I)$ , reflects the extent of breakdown of the injected protein, since the  $I^{131}$  label is probably lost when the protein is degraded. Large changes in the  $RIR(S/I)$  were observed in the organ proteins of the recipients.

The passage of double labelled  $I^{131}$ - $S^{35}$ -rabbit or guinea pig albumins from the lymph into the blood plasma is not accompanied by any significant breakdown of the protein molecule.

Heavily iodinated (about 8%)  $S^{35}$ -rabbit albumins when injected into rabbits were rapidly eliminated and catabolized.

Rat serum albumins and globulins labelled with both  $S^{35}$  and  $C^{14}$ -amino acids were injected into rats. The change in the  $S^{35}/C^{14}$  ratio from that of the injected proteins,  $RIR(S/C)$ , was determined for various proteins of the recipient animals. In the serum and most of the organ proteins there was essentially no change in the  $RIR(S/C)$  over a period of 9 days. Reutilization of both  $S^{35}$  and  $C^{14}$  breakdown products probably occurred in these cases. A large increase in the  $S^{35}/C^{14}$  ratio from that of the injected proteins occurred in the hair, since the higher sulfur content of the hair resulted in a greater reutilization of  $S^{35}$  breakdown products than that of  $C^{14}$  breakdown products.

A method was developed for the quantitative determination of  $C^{14}$  and  $S^{35}$  in double labelled proteins. The protein is subjected to alkali fusion in the presence of nitrate, converting all sulfur and carbon of the protein to sulfate and carbonate respectively.  $CO_2$  is released by acidification and trapped in sodium hydroxide. The barium salts are prepared and counted.

Microfilm \$2.00; Xerox \$6.40. 135 pages.

#### THE N-TERMINAL AMINO ACIDS OF $\alpha$ -CASEIN AND THE COMPOSITION OF RADIATION-STERILIZED CASEIN

(L. C. Card No. Mic 58-2792)

Charles M. Ise, Ph.D.  
The Florida State University, 1958

The purpose of this study is to determine the effects of a sterilizing dose of radiation on the amino acid composition and on the peptide bonds in a nutritionally

critical protein, casein. An additional objective is to clarify the quantitative knowledge of the N-terminal amino acid residues in  $\alpha$ -casein, particularly inasmuch as information obtained by the dinitrofluorobenzene procedure is conflicting.

The amino acid content of the irradiated and unirradiated casein hydrolysates was determined microbiologically, and the difference was considered to be the loss of the amino acid by the irradiation. The N-terminal amino acid residues were determined by means of the subtractive phenyl isothiocyanate (PTC) method. The N-terminal residues are not available to the microorganisms for growth after treatment with the PTC reagent and subsequent hydrolysis. Therefore, the N-terminal amino acid can be determined by difference between the untreated and the PTC-treated casein.

The results show that casein provides difficulties in quantitation, as already demonstrated by the discrepancies on the N-terminal arginine determined by the DNP method. The difference between the control and the treated samples of casein is found to be small.

The amino acids studied in casein (arginine, histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tyrosine, and valine) are not measurably altered by 10 million rep from a 2 Mev Van de graaf generator, except for tyrosine. The peptide bonds of casein are not detectably cleaved by this dose of radiation.

The microbial determination for the N-terminal arginine residues indicate that the earlier value, by the DNP method, of 11 residues per  $10^5$  g. of  $\alpha$ -casein is too high. The value found of  $3.6 \pm 1.3$  N-terminal arginine residues per  $10^5$  g. of  $\alpha$ -casein by the PTC method is close to a second N-terminal arginine evaluation on  $\alpha$ -casein from another laboratory. The values reported for N-terminal lysine were 1.4 and 1.5 residues per  $10^5$  g. of protein; however, the number found in this investigation is  $7.1 \pm 1.5$  lysine residues per  $10^5$  g. of protein. This discrepancy is explainable by difficulties encountered in the DNP method.

The microbial assays are amenable to statistical analyses, whereas other methods used in protein analysis are not. The results of a statistical analysis suggest that a critical review of the factors causing variability in amino acid assays would be rewarding.

Microfilm \$2.00; Xerox \$5.60. 111 pages.

#### PARTIAL PURIFICATION AND PROPERTIES OF RENAL GLUTAMINASE

(L. C. Card No. Mic 58-2738)

Jack Dennis Klingman, Ph.D.  
Duke University, 1958

Supervisor: Philip Handler

Krebs showed the presence of glutaminases in tissues and observed inhibition of this activity by glutamate.

Greenstein and co-workers, by centrifugal fractionation of liver found a mitochondrial glutaminase stimulated by phosphate and called this glutaminase I. Butanol

fractionation of kidney gave Otey et al. a stable preparation which was activated by phosphate, arsenate or sulfate but not by borate.

Shepard and Kalnitsky showed the product of this enzymatic hydrolysis is glutamate rather than pyrrolidone carboxylic acid which is produced non-enzymatically.

Van Slyke et al. found that the glutamine amide nitrogen could account for 60% of the urinary ammonia. Infusion studies by Kamin and Handler in dogs showed that L-glutamine, L-aspartic acid, L or D,L-alanine and L-histidine gave the greatest yield of urinary ammonia. Yudkin and Davies showed that acidotic rat kidney slices used L-glutamine, L-leucine and glycine for ammonia.

We noted that homogenization of kidney in water released up to 50% of the glutaminase activity into the supernatant. Treatment of isolated mitochondria with water, sodium lauryl sulfate, digitonin or desoxycholate did not increase the solubilization. The butanol procedure of Otey et al. was used to prepare a powder from which a water extract of glutaminase could be obtained. It was found to contain and to irreversibly bind glutamate. Dialysis of this water extract removed but did not prevent the binding of glutamate. Partial purification of the enzyme has been achieved by the following manipulations: Kidney is homogenized in 0.25 M sucrose and the coarse particles are centrifuged off. The supernatant is passed through cheese cloth and the mitochondria isolated by centrifugation in a Sharples. Lyophilization of the mitochondria is followed by homogenization in pure butanol at 0° and the resulting powder extracted with 0.01 M borate. This extract is clarified by centrifugation, the protein precipitated by 1.33 M  $P_i$ , pH 8.0, redissolved in borate, and the precipitate at 1.33 M  $P_i$  collected and redissolved. This is placed on a XE-97 column and eluted with a borate-glycine buffer. The last procedure is repeated yielding 80% of the original activity and 300 fold purification from the kidney.

The twice phosphate-precipitated material shows glutathionase activity which is accelerated by glutamine, whereas after chromatography this activity is lost. The presence of glutathione lowers the glutaminase activity although the amount of ammonia and glutamate evolved are equivalent. The pH optimum is 8.0. The enzyme is inhibited by p-chloromercuribenzoate at  $10^{-5}$  M and is not reactivated by glutathione or cysteine. Pyrophosphate is a better "activator" than phosphate, arsenate or sulfate, while borate, monovalent anions or pyruvate have no effect.

The unique feature of this enzyme is the "activation" by phosphate which is maximal at 0.4 M. The action of phosphate is not necessarily activation, since preincubation of enzyme in varying phosphate concentrations followed by the addition of substrate and phosphate exhibited identical activity as the same phosphate concentrations without preincubation. Without phosphate, 50% inactivation of glutaminase at 37° occurred in 20 seconds. Borate appears to protect the enzyme while preventing enzymatic activity. Equimolar borate at a given phosphate concentration results in 50% inhibition of glutaminase activity.

The  $K_m$  of glutamine was approximately  $5 \times 10^{-3}$  M while ammonia was a competitive and glutamate a non-competitive inhibitor. When ammonia, glutamate and glutamine in equimolar concentrations with either  $C^{14}$ -glutamate or  $N^{15}$ -ammonia were incubated with glutaminase

the resulting glutamine contained only  $N^{15}$ . The amount depended on the pH, being greatest near the pK of ammonia. Azaserine which produced 50% inhibition of glutaminase activity caused no inhibition of  $N^{15}$  incorporation.

Microfilm \$2.00; Xerox \$3.00. 46 pages.

# CHEMICAL STRUCTURE OF ALFALFA SEED GALACTOMANNAN AND A RAPID METHYLATION PROCEDURE

(L. C. Card No. Mic 58-3179)

Robert Joseph McCredie, Ph.D.  
Purdue University, 1958

Major Professor: Roy L. Whistler

Alfalfa seed, *Medicago sativa*, contain 6% hot-water extractible carbohydrate material. Ethanol fractionation shows that this carbohydrate mixture is composed of at least two polysaccharides. The major component (75%) of this mixture is a galactomannan,  $[\alpha]_D^{25} + 90 \pm 2^\circ$  (c 0.4, N potassium hydroxide), which contains 52% anhydromannose and 48% anhydrogalactose as determined by quantitative paper chromatography.

Fragmentation analysis shows that the structure of Alfalfa seed galactomannan is similar to guaran since three crystalline oligosaccharides obtained from a partial acid hydrolyzate of alfalfa seed galactomannan are identical to those isolated from both acidic and enzymatic hydrolyzates of guaran. These crystalline oligosaccharides are 4-O- $\beta$ -D-mannopyranosyl- $\beta$ -D-mannopyranose, 6-O- $\alpha$ -D-galactopyranosyl- $\beta$ -D-mannopyranose and  $\beta$ -D-mannopyranosyl-(1 $\rightarrow$ 4)- $\beta$ -D-mannopyranosyl-(1 $\rightarrow$ 4)- $\beta$ -D-mannopyranose. A fourth oligosaccharide appears to be  $\alpha$ -D-galactopyranosyl-(1 $\rightarrow$ 6)- $\beta$ -D-mannopyranosyl-(1 $\rightarrow$ 4)- $\beta$ -D-mannopyranose which is identical to another oligosaccharide from guaran.

Periodate oxidation of the galactomannan indicates that 92% of the D-mannopyranoses in the  $\beta$ -(1 $\rightarrow$ 4) linear chain contain single D-galactopyranose units attached to them by  $\alpha$ -(1 $\rightarrow$ 6)-linkages.

Upon complete methylation, a methylated galactomannan with a methoxyl content of 45.4% was obtained. Hydrolysis of this polymer yields 2,3,4,6-tetra-O-methyl-D-galactopyranose (47%), 2,3,6-tri-O-methyl-D-mannopyranose (6%), and 2,3-di-O-methyl-D-mannopyranose (47%) which show that 90% of the D-mannopyranoses in the  $\beta$ -(1 $\rightarrow$ 4) linear chain contained single D-galactopyranosyl units attached to them by  $\alpha$ -(1 $\rightarrow$ 6)-linkages.

A method of rapid methylation of galactomannans was developed. Both guar and alfalfa seed galactomannans can be fully methylated in a one step procedure which requires only one day. Microfilm \$2.00; Xerox \$3.00. 43 pages.

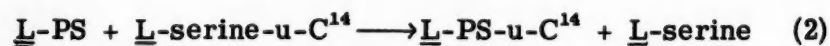
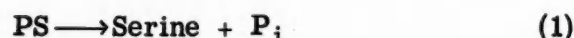
# METABOLISM OF PHOSPHOSERINE-O-PHOSPHOSERINE PHOSPHATASE

(L. C. Card No. Mic 58-2743)

Francis Clemens Neuhaus, Ph.D.  
Duke University, 1958

Supervisor: William L. Byrne

In the past two years two publications (J. Biol. Chem., 224, 331 (1957); Proc. Nat. Acad. Sc., 41, 605 (1955)) gave evidence for phosphoserine (PS) as an intermediate in the biosynthesis of serine from carbohydrate precursors. The availability of PS to the cell suggested that it might be metabolized by pathways other than dephosphorylation to serine. Preliminary attempts to demonstrate either the decarboxylation of PS or the formation of glycine and a phosphorylated C<sub>1</sub> fragment were negative; however, the following reactions were found to be catalyzed by enzyme preparations from chicken and rat liver:



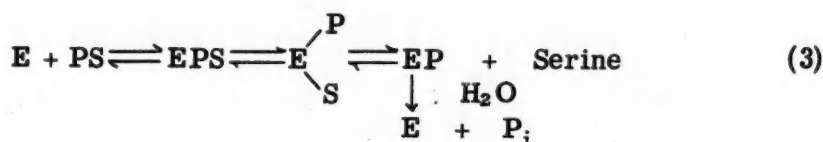
The phosphatase activity, Reaction 1, was purified 20 fold starting with aqueous extracts of chicken liver acetone powder. The purified preparation was highly specific for PS. At low substrate concentrations it was specific for L-PS while at high substrate concentrations it dephosphorylated D-PS. Identical maximum velocities were observed for both isomers. The only other substrate dephosphorylated at any appreciable rate was p-nitrophenyl phosphate which was due to a contaminating, uncharacterized phosphatase. These results are in contrast to the conclusion of Ichihara and Greenberg (J. Biol. Chem., 224, 331 (1957)) that the major pathway for the cleavage of PS was carried out by a non-specific phosphatase(s) present in rat liver-extracts.

When activities toward Reaction 1 and 2 were determined at each step of the purification procedure, it was found that the activities fractionated in a parallel manner. Reactions 1 and 2 showed an absolute requirement for a divalent cation. The ratio of the phosphatase activity at pH 5.90 to the exchange activity at pH 7.12 was one. The pH optimum for Reaction 1 was 5.9-6.6 whereas for Reaction 2 it was pH 6.9-7.3. Simple reversal of Reaction 1 as an explanation for Reaction 2 was ruled out by showing that the enzyme did not catalyze a detectable incorporation of P<sup>32</sup> labeled orthophosphate into PS under the conditions of a typical exchange experiment.

L-serine was found to be a very effective inhibitor of the phosphatase activity. Many compounds which are similar in structure to serine do not inhibit. Of those tested only glycine, D-serine, and DL-alanine had any effect on the phosphatase activity besides L-serine. Lineweaver-Burk plots showed that the L-serine inhibition was uncompetitive. Inhibition by L-serine did not follow the exchange reaction as a function of pH. However, K<sub>B</sub>, the concentration of L-serine that inhibits the phosphatase activity 50 per cent, and the concentration of L-serine needed for one-half maximal exchange were identical at the pH optimum of the exchange reaction. It was found that the en-

zyme preparation would catalyze the transfer of a phosphoryl group from D-PS to L-serine-u-C<sup>14</sup> to form L-PS-u-C<sup>14</sup>.

A proposed mechanism consistent with these data is as follows:



A steady-state kinetic treatment of the above mechanism was found to be consistent with these data. The binding of serine to the proposed phosphoryl-enzyme which inhibits the phosphatase activity occurs over a broad pH range (5-8) whereas the incorporation reaction requires the proper species of the phosphoryl-enzyme whose pH optimum is 6.9-7.3. Since no acceptors other than L-serine have been found for Reaction 2, it is doubtful that the enzyme functions as a transferase. The effective inhibition by L-serine suggested that PS phosphatase could control serine biosynthesis from carbohydrate precursors.

Microfilm \$2.00; Xerox \$6.20. 129 pages.

## A STUDY OF THE EFFECT OF CARNOSINE ON THE METABOLISM OF FROG MUSCLE HOMOGENATES

(L. C. Card No. Mic 58-2895)

Charles J. Parker, Jr., Ph.D.  
The University of Buffalo, 1958

To study the possible effects of the muscle compounds anserine and carnosine in metabolism, it was necessary to find conditions under which the oxidative reactions of isolated muscle function normally. Frog muscle homogenates in trishydroxymethyl aminomethane buffer at pH 7.4 containing 0.12 M KCl, 0.016 M NaCl and 0.014 M MgCl<sub>2</sub>, and in the unbuffered salt solution at pH 6.0 appeared to be suitable. For maximal respiration ethylene diaminetetraacetic acid and adenosine triphosphate were essential. Oxygen consumption was greater at pH 7.4 than at 6.0. Adenosine triphosphate appears to have an indirect action on the respiration of the homogenate, as it is dephosphorylated to adenosine diphosphate by the homogenate in 3 to 5 minutes, whereas oxygen utilization continues much longer. The diphosphate is deaminated to an inosine nucleotide in 30 minutes. Adenylic acid caused a slight stimulation of respiration, but was completely deaminated to inosinic acid within 3 minutes by the homogenate. Inosine triphosphate and inosinic acid showed no effect on respiration. Since the stimulatory effect of adenosine triphosphate on respiration persisted for 30 to 60 minutes after deamination appeared to be complete, its action was assumed to be due to its breakdown to a phosphate acceptor which could stimulate oxidative phosphorylation. Inosine triphosphate, inosinic acid and adenylic acid do not appear to be this acceptor. Carnosine had no effect on respiration or the formation of creatine phosphate. The action of carnosine on the synthesis of adenosine triphosphate could

not be followed because of the highly active adenosine triphosphatase in the muscle homogenate. Attempts to duplicate the findings of Severin, *et al.*, that carnosine and anserine accelerate oxidation and phosphorylation in muscle homogenates were not successful. The effects of carnosine analogues (propionyl histidine, acetyl histidine, anserine, histidine and carnosine methyl ester) on the respiration of muscle homogenates was also studied to gain further insight into the mechanism of the action of carnosine in muscle. Anserine, histidine and the acylated derivatives of histidine had no effect on oxygen consumption. Carnosine methyl ester, however, stimulated respiration. Methanol caused a slight stimulation and this was attributed to the formation of a small amount of the ester from the endogenous carnosine. The ester may have been more readily converted to a metabolically active form of carnosine than the free base. The results warrant further investigation. Microfilm \$2.00; Xerox \$5.00. 96 pages.

THE ROLE OF PHOSPHOGLYCERIC ACID  
SALTS IN THE SOLUBILIZATION OF  
INORGANIC SUBSTANCES IN NATURE

(L. C. Card No. Mic 58-2881)

Robert Henry Salvesen, Ph.D.  
Polytechnic Institute of Brooklyn, 1958

Adviser: Dr. G. Oster

The importance of phosphorus compounds in metabolism has been established by the work of many investigators. Recently Neuberg and others have shown that rather simple naturally occurring phosphates can solubilize many physiologically important substrates. This dissertation is an extension of these latter studies.

In the present thesis it has been shown that the sodium salt of D-3-phosphoglyceric acid (sodium PGA) can be used to dissolve many water insoluble compounds such as bio-metal carbonates, phosphates, etc. In addition, this substance can also prevent the precipitation of numerous substrates. This solvent action takes place at a pH of 7 and without heating.

Since PGA and its salts are known to be present in the blood stream and other parts of humans as well as most animals, it may be postulated that various substrates could be transported in soluble form by this material. Perhaps under physiological conditions a more complicated molecule containing the same functional groups is actually responsible for this phenomenon, but this work has shown that a simple compound such as PGA exhibits remarkable solubility powers in relatively dilute solutions.

By the action of phosphatase, under physiological conditions of pH and temperature, it has been shown that the solubilized material can be precipitated as the metal phosphate. Figures which indicate the amount of phosphate precipitated as a function of time are included.

The eight most common bio-metals calcium, cobalt, copper, iron, magnesium, nickel and zinc were selected for detailed studies. (Barium salts could not be investigated because of the low solubility of these materials in PGA). Optical activity measurements were carried out on

all of the salts investigated which indicated complexes were formed. In addition, the magnetic susceptibilities of two salts, namely, the cobalt and nickel salts were studied using the Gouy method. The results proved a square planar nickel complex was formed, but the studies on the cobalt were inconclusive.

In order to determine the nature of the compounds formed between the various cations and PGA, the method of continuous variations was employed. These studies indicated that the expected 1:1 ratio existed between the PGA ions and divalent ions of calcium, copper, nickel and manganese. This means that a compound such as MPGA (where M is a divalent cation) was formed in each case. Similar tests with a cobalt nitrate revealed that a double salt such as cobalt PGA dinitrate probably was formed. Inconclusive results were obtained with the corresponding system of magnesium and iron (ferric) salts with sodium. It was not possible to examine the nature of the zinc PGA compound by this method since zinc salts do not absorb light of the wavelengths available on the spectrophotometer employed.

Microfilm \$2.00; Xerox \$6.00. 123 pages.

ISOLATION AND SOME PROPERTIES OF SOME  
MALTODEXTRIN SACCHARIDES

(L. C. Card No. Mic 58-3021)

John Anthony Thoma, Ph.D.  
Iowa State College, 1958

Supervisor: Dexter French

The method of continuous variation has been extended to some special ternary systems. When the  $\alpha$ -I<sub>2</sub>-I<sup>-</sup> system was studied by this method, it was found that in addition to the I<sub>3</sub><sup>-</sup> complex  $\alpha$ I<sub>2</sub> and  $\alpha$ I<sub>3</sub><sup>-</sup> complexes could be detected spectrophotometrically. The dissociation constant for the  $\alpha$ I<sub>2</sub> complex was evaluated spectrophotometrically to be  $1.15 \pm 0.15 \times 10^{-4}$ .

The maltodextrins from glucose to maltooctadecaose have been separated by partition chromatography on cellulose columns.

All of the maltodextrins having more than five units when placed in I<sub>2</sub>-I<sup>-</sup> solutions enhanced the I<sub>3</sub><sup>-</sup> spectra indicating that they formed dextrin I<sub>3</sub><sup>-</sup> complexes. Visible enhancement of the spectra was detected for dextrins containing 18 or more glucose units. When papergrams of the maltodextrins were sprayed with methanolic I<sub>2</sub>-KI, all saccharides above DP 8 were stained.

The first and second apparent dissociation constants for dextrin I<sub>3</sub><sup>-</sup> and dextrin I<sub>5</sub><sup>-</sup> complexes were evaluated electrometrically. The apparent equilibrium constants, determined by titrating the dextrins with I<sub>2</sub> in excess KI, correspond to the following equilibria:

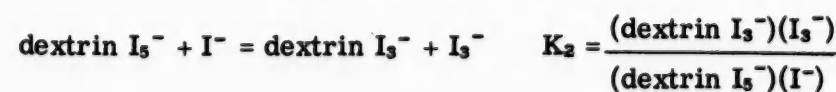


Table 1. Apparent dissociation constants

$G_n^*$	$K_1 \times 10^3$	$K_2 \times 10^3$
$G_4$	15 $\pm$ 4	
$G_5$	11 $\pm$ 2	
$G_6$	6.8 $\pm$ 0.4	
$G_7$	6.8 $\pm$ 0.4	
$G_8$	5.5 $\pm$ 0.4	
$G_9$	4.0 $\pm$ 0.4	
$G_{10}$	3.0 $\pm$ 0.3	33 $\pm$ 20
$G_{11}$	2.2 $\pm$ 0.2	9.9 $\pm$ 1.5
$G_{12}$	1.4 $\pm$ 0.1	5.4 $\pm$ 0.8
$G_{13}$	1.2 $\pm$ 0.1	2.7 $\pm$ 0.5
$G_{14}$	0.92 $\pm$ 0.1	2.1 $\pm$ 0.4
$G_{15}$	0.73 $\pm$ 0.07	1.2 $\pm$ 0.2

\* $G_n$  corresponds to a maltodextrin containing  $n$  glucose units.

The binding capacities of the maltodextrins have been interpreted in terms of the helical theory.  
Microfilm \$2.00; Xerox \$4.60. 86 pages.

#### PROTEIN STRUCTURAL STUDIES

(L. C. Card No. Mic 58-2943)

James Edward Turner, Jr., Ph.D.  
Indiana University, 1958

Three aspects of protein structure were investigated. The first study was concerned with peptide subunits bound together by disulfide bonds in protein molecules. The second study was a search for gamma-glutamyl residues in protein molecules, and the third was an investigation of the surface charge of some globular protein molecules.

The presence of peptide subunits held together by disulfide bonds was investigated by molecular weight measurements. The molecular weights of several proteins were determined before and after cleavage of disulfide bridges. A decrease in molecular weight after splitting disulfide bonds would indicate that subunits were present. Molecular weights were determined with a light scattering photometer. Disulfide bonds were cleaved by reacting the protein with either performic acid or sodium sulfite. The proteins were allowed to react with performic acid at 25°C. for 30 minutes; in this way the disulfide bridges were oxidized to sulfonic acid groups. When the proteins were reacted with sodium sulfite the disulfide bonds were converted to sulfhydryl and thiosulfonic acid groups. Bovine serum albumin, bovine gamma-globulin, pepsin, ovalbumin, and edestin were found to possess no peptide subunits bound together by disulfide bonds.

A search was also made for a specific type of disulfide bond formed by a cystine molecule possessing a free amino group. This type of cystine residue was detected by the dinitrophenylation procedure. The protein was dinitrophenylated with 1-fluoro-2,4-dinitrobenzene, oxidized with performic acid, and hydrolyzed in hydrochloric acid. The presence of DNP-cysteic acid in the hydrolyzate was taken as evidence for the existence of the N-terminal half-cystine residue in the native protein. DNP-cysteic acid was identified by means of paper chromatography. An

N-terminal half-cystine residue was found in chymotrypsin and horse serum albumin. None of the other 16 proteins analyzed possessed such a group.

Through the use of model compounds it was shown that alpha-glutamyl residues form alpha-glutamyl hydrazides whereas gamma-glutamyl residues form gamma-glutamyl hydrazides when subjected to hydrazinolysis. The two monohydrazides were identified on paper chromatographs after dinitrophenylation with 1-fluoro-2,4-dinitrobenzene. None of the 15 proteins studied were found to possess any detectable gamma-glutamyl residues. The results of this study were discussed in relation to the suggestion by others that such groups exist in certain protein molecules.

The surface charge of globular proteins was studied by means of a large counter ion which could not penetrate into the interior of the protein molecule. In this work the presence and number of anionic groups on the surface of ovalbumin, edestin, and the serum proteins were examined by means of the large salmine cation.

Insoluble protein-salmine complexes were studied when salmine was added to the various protein solutions in the pH range 2 to 11. Native serum albumin did not form an insoluble complex with salmine between pH 2 and 10 whereas native serum globulins and edestin formed such complexes between pH 6 and 11. Heat-denatured serum albumin and serum globulins bound more salmine molecules than the native proteins. The number of salmine molecules bound per protein molecule was determined at pH 6, 8, and 10. It varied from 1 to 39 molecules of salmine per protein molecule.

Soluble complexes between salmine and proteins were studied by light scattering and electrophoresis. Bovine serum albumin formed a soluble complex with salmine at pH 8.6 and above; however, no soluble complex could be detected at pH 5.6.

By correlating these data with previous work in which protein-anion complexes were investigated it was concluded that the serum globulins possess a negatively charged surface whereas the serum albumin molecule has a positively charged surface.

Microfilm \$2.00; Xerox \$5.20. 110 pages.

#### CHEMISTRY, INORGANIC

##### THE "DIAMMONIATE OF TETRABORANE ( $B_4H_{10}$ )" AND RELATED SUBSTANCES

(L. C. Card No. Mic 58-3690)

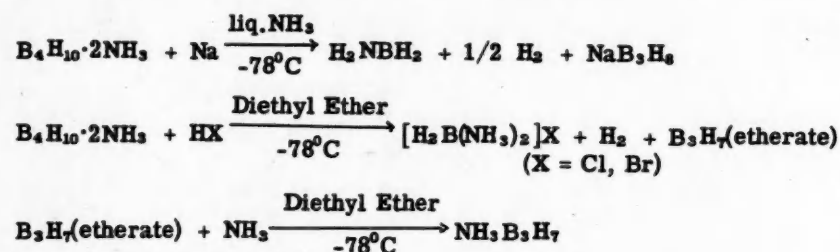
Goji Kodama, Ph.D.  
University of Michigan, 1958

The objectives of this investigation were: 1) the positive identification and characterization of any definite compounds formed between ammonia and tetraborane, 2) the elucidation of the structures of such compounds where data permitted, and 3) the application of this information to a systematic treatment of the chemistry of tetraborane.

The reactions between ammonia and tetraborane were studied: 1) in the presence and 2) in the absence of diethyl ether as a solvent. 1) From the slow interaction of ammonia

and tetraborane in diethyl ether at  $-78^{\circ}\text{C}$ , the white crystalline compound  $\text{B}_4\text{H}_{10}\cdot 2\text{NH}_3$  was obtained. The new compound is stable at room temperature and it is soluble in dry ether. 2) From the direct reaction between tetraborane and an excess of ammonia in the absence of solvent no evidence for the compound  $\text{B}_4\text{H}_{10}\cdot 4\text{NH}_3$ , described by Stock, Wiberg and Martini, was obtained. It is suggested that the tetraammoniate of tetraborane mentioned by these workers was probably a mixture consisting of a normally stable ammoniate of  $\text{B}_4\text{H}_{10}\cdot 2\text{NH}_3$  and yet unidentified substances.

The structural formula  $[\text{H}_2\text{B}(\text{NH}_3)_2]^+[\text{B}_3\text{H}_8]^-$  has been assigned to the diammoniate of tetraborane on the basis of its properties and the following chemical evidence:



The compounds  $[\text{H}_2\text{B}(\text{NH}_3)_2]\text{Cl}$  and  $[\text{H}_2\text{B}(\text{NH}_3)_2]\text{Br}$  obtained by the above reaction appear to be of relatively high purity.

The new ammonia addition compound of the triborane group,  $\text{NH}_3\text{B}_3\text{H}_7$ , described above, was synthesized and characterized in this study. Two synthetic methods were employed. These are: 1) the reaction between  $\text{NaB}_3\text{H}_6$  and  $\text{NH}_4\text{X}$  ( $\text{X} = \text{Cl}, \text{Br}$ ) in diethyl ether at room temperature, and 2) the low temperature displacement of ethers by ammonia in triborane etherates (ethers = tetrahydrofuran, tetrahydropyran and diethyl ether).

The observations of this investigation, together with observations from other laboratories show a remarkably close similarity in the reactions of  $\text{B}_2\text{H}_6$  and  $\text{B}_4\text{H}_{10}$  with bases. The reactions of  $\text{B}_2\text{H}_6$  and  $\text{B}_4\text{H}_{10}$  with different bases have been interpreted in terms of symmetrical and nonsymmetrical cleavage of the double bridge bonds. Ammonia, the amide group and probably  $\text{H}_2\text{O}$  and  $\text{OH}^-$  favor nonsymmetrical cleavage of the double bridge bonds. All other bases reported in the literatures favor the symmetrical cleavage.

Mechanistic arguments have been utilized to explain details of observed reactions.

Microfilm \$2.00; Xerox \$5.40. 109 pages.

#### PHASE RELATIONSHIPS IN METAL SILICIDES AND GERMANIDES

(L. C. Card No. Mic 58-2875)

John A. Perri, Ph.D.

Polytechnic Institute of Brooklyn, 1958

Advisers: Ephraim Banks and Benjamin Post

X-ray diffraction techniques were employed to study solid state phase transitions in tungsten trioxide and the rare earth disilicides, some new phases and phase relationships in chromium and vanadium silicides and germanides were also investigated. A high temperature diffrac-

tometer with some unique features was constructed to fit the North American Philips high angle goniometer. This instrument is capable of recording the diffraction pattern of a powdered sample up to ca.  $1450^{\circ}\text{C}$ . in vacuum, air or inert atmosphere. It is convenient to use and requires only infrequent repairs.

The orthorhombic-tetragonal phase transition which occurs at  $720^{\circ}\text{C}$ . in tungsten trioxide was investigated in order to test this instrument's capabilities. Since this work had previously been done by film methods it was considered a good test. Some interesting detailed information concerning this transition is discussed.

The disilicides of lanthanum, cerium and praseodymium have the tetragonal thorium disilicide structure; it has been found that the disilicides of neodymium, samarium, gadolinium and dysprosium crystallize with an orthorhombic distortion of this structure. The difference between the axial lengths in the "a" and "b" directions increases with decreasing metal radius. Europium disilicide is exceptional in that it forms the tetragonal modification. This anomaly is discussed in terms of the metallic radii of the rare earth metals. It has also been found that the orthorhombic disilicides transform to the tetragonal form when heated. The transition temperatures increase with decreasing metallic radii. Europium and praseodymium disilicide transform to orthorhombic when cooled below room temperature.

A single crystal analysis of the orthorhombic form of gadolinium disilicide showed that the space group is Imma with four formula weights per unit cell, the positional parameters of the atoms were measured as  $Z_{\text{Gd}} = 0.3750$  and  $Z_{\text{Si}} = 0.3750 \pm 0.4112$ . The X-ray data coupled with density measurements and chemical analysis indicate that the silicon-gadolinium ratio is 1.3-1.4 rather than 2.0, as indicated by the formula. The silicon parameters and the defect structure are discussed in terms of the silicon-silicon bond lengths.

The X-ray data indicate that the isomorphous compounds  $\text{Cr}_5\text{Si}_3$ ,  $\text{Cr}_5\text{Ge}_3$ ,  $\text{V}_5\text{Si}_3$  and  $\text{V}_5\text{Ge}_3$  have compositions closer to  $\text{Cr}_3\text{Si}_2$ ,  $\text{Cr}_3\text{Ge}_2$ ,  $\text{V}_3\text{Si}_2$  and  $\text{V}_3\text{Ge}_2$ . The Nowotny phase of  $\text{Cr}_5\text{Ge}_3$  (C) has been prepared and the hexagonal unit cell was measured as having  $a = 7.11 \text{ \AA}$  and  $c = 4.85 \text{ \AA}$ . A new phase of unknown carbon content was prepared by firing  $\text{Cr}_5\text{Ge}_3$  in graphite crucibles. The X-ray powder pattern of this phase could be indexed on the basis of a tetragonal unit cell with  $a = 5.68 \text{ \AA}$  and  $c = 5.11 \text{ \AA}$ . This phase was not formed with " $\text{Cr}_5\text{Si}_3$ " was fired in graphite.

Chromium digermanide was found to be stable below  $1050^{\circ}\text{C}$ . It is not isomorphous with the corresponding silicide. Its X-ray powder pattern can be indexed on the basis of an orthorhombic unit cell with  $a = 6.40 \text{ \AA}$ ,  $b = 6.75 \text{ \AA}$  and  $c = 7.50 \text{ \AA}$ .

A phase whose composition corresponds to  $\text{Cr}_4\text{Ge}_3$  was found in the chromium-germanium system; its X-ray powder pattern could not be indexed.

Solid solutions of the type  $\text{Cr}_5\text{Ge}_{3-x}\text{Si}_{x(1.117)}$  were prepared; the lattice constants were approximately linear functions of  $x$ . The factor 1.117 takes the stoichiometry difference between  $\text{Cr}_5\text{Ge}_3$  and  $\text{Cr}_3\text{Si}_2$  into account. Expansion data indicate an anomalously high expansion coefficient in the "c" direction of  $\text{Cr}_5\text{Ge}_3$  as compared to " $\text{Cr}_5\text{Si}_3$ " and  $\text{Cr}_5\text{Ge}_{1.5}\text{Si}_{1.5}$ .

Lattice constant measurements indicate at least a partial solubility between the Nowotny phases of  $\text{Cr}_5\text{Ge}_3$  and

"Cr<sub>3</sub>Si<sub>3</sub>". No indication of appreciable solid solution between CrSi<sub>2</sub> and CrGe<sub>2</sub> was found.

Microfilm \$2.00; Xerox \$5.60. 114 pages.

## CHEMISTRY, ORGANIC

### STERIC EFFECTS IN THE SCHMIDT REACTION OF ORTHO-SUBSTITUTED BENZOPHENONES

(L. C. Card No. Mic 58-3632)

Emilios Polycarpou Antoniades, Ph.D.  
University of Michigan, 1958

The Schmidt reaction of  $\alpha$ -naphthyl phenyl ketone and o-methyl-, o-ethyl, o-isopropyl and o-ter-butyl-benzophenone, and the Beckmann rearrangement of their oximes of equilibrated geometrical configuration, have been studied with respect to ratios of isomeric amides produced. The composition of the product mixtures was determined by infrared spectroscopy.

For the first four ketones, yields were high (>90%), and at 60° the ratios fell in the range 18:82 to 30:70 for the Schmidt products, and 5:95 to 15.5:84.5 for the Beckmann, with migration of unsubstituted phenyl predominating. The oximations were also carried out at 118°, under which conditions the amide ratios were much closer to those from the Schmidt reaction (at 60°). From the results at the two temperatures, entropy differences could be estimated for the pairs of *syn* and *anti* oximes of o-methyl, o-ethyl, and o-isopropyl-benzophenone; in each case the *anti*-phenyl isomer was apparently of lower entropy.

o-ter-Butylbenzophenone was inert to carbonyl reagents even under forcing conditions; at best, a yield of only 1.2% of amides could be obtained by the Schmidt reaction. The isomer ratio, 70:30, showed predominant migration of o-ter-butylphenyl, in complete contrast to the other o-alkylbenzophenones.

An explanation has been adduced for these *prima facie* anomalous ratios, which takes into account the rotational conformation of the benzene rings and their electronic interaction with the double bond of the carbonyl group and its derived intermediates. This new concept of an "ortho effect" is also successful in correlating isomer ratios from Schmidt reactions and oximation plus Beckmann rearrangement with the diaryl ketones previously reported in the literature.

The effect of some changes in reaction medium has been explored for the Schmidt reaction on o-methylbenzophenone. Both sulfuric acid and trifluoroacetic acid gave rise to appreciable amounts of side-products (aminotetrazoles and diarylureas, respectively), which were not encountered when trichloroacetic acid was used as the solvent.

Incidental to the work, the new compounds o-ethylbenzophenone dinitrophenylhydrazine, o-isopropylbenzonitrile, o-isopropylbenzamide, o-isopropylbenzanilide, o-isopropylbenzophenone and its dinitrophenylhydrazine, o-ter-butylbenzophenone, its imine and hydrochloride, and o-ter-butylbenzanilide have been prepared and characterized.

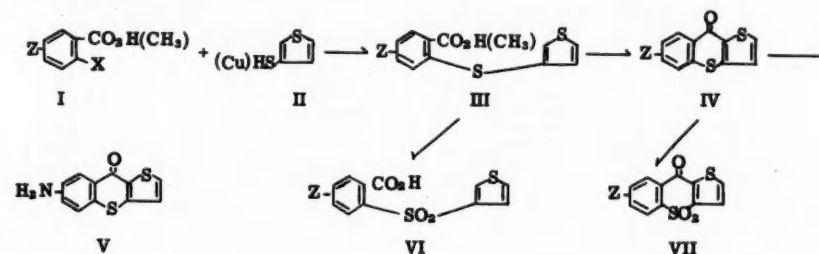
Microfilm \$2.00; Xerox \$6.40. 133 pages.

### THE SYNTHESIS OF SOME SUBSTITUTED THIENO[3,2-b]THIACHROMONES

(L. C. Card No. Mic 58-2898)

Burton Lawrence Appleton, Ph.D.  
Indiana University, 1958

As precursors for potential chemotherapeutic agents against schistosomiasis, a debilitating parasitic worm disease, 5-, 6-, 7- and 8-aminothieno[3,2-b]thiachromones were synthesized by the sequence I + II  $\rightarrow$  III  $\rightarrow$  IV  $\rightarrow$  V (Z = NO<sub>2</sub>).



3-Thiophenethiol (II) was condensed with 2-bromo-3-nitrobenzoic acid and with 2-chloro-5-nitrobenzoic acid in basic media to give respectively, 3- and 5-nitro-2-(3-thienylthio)benzoic acid. Cuprous 3-thienylmercaptide was condensed with methyl 2-iodo-4- and 6-nitrobenzoate at elevated temperatures to give respectively, methyl 4- and 6-nitro-2-(3-thienylthio)benzoate, the latter impure. Hydrolysis of the esters afforded the corresponding acids. Treatment of the 3-, 4-, 5- and 6-nitro acids (III) with thionyl chloride followed by stannic chloride in the cold afforded the 5-, 6-, 7- and 8-nitrothieno[3,2-b]thiachromones (IV), the 3-nitro isomer of III, however, cyclizing with thionyl chloride alone. Reduction of IV with stannous chloride yielded the amines (V), the purification of the 5-isomer, however, being effected through its acetyl derivative.

3-Thiophenethiol was condensed with 2,4-dichlorobenzoic acid in the presence of potassium carbonate and small amounts of copper powder and potassium iodide in Dowtherm A to 4-chloro-2-(3-thienylthio)benzoic acid (III, Z = 4-Cl) in an unsatisfactory preparation. The acid was cyclized with polyphosphoric acid in the presence of a little phosphoryl chloride to 6-chlorothieno[3,2-b]thiachromone (IV, Z = 6-Cl). Similar attempts to obtain the 8-chloro isomer of IV met with little success due to difficulties in synthesizing 6-chloro-2-(3-thienylthio)benzoic acid.

Thieno[3,2-b]thiachromone (IV, Z = H) was obtained by condensing cuprous 3-thienylmercaptide with methyl o-iodobenzoate to methyl o-(3-thienylthio)benzoate, which was hydrolyzed to the acid (III, Z = H). The acid was then cyclized either directly with polyphosphoric acid in the presence of a little phosphoryl chloride or with thionyl chloride followed by stannic chloride. This route to the parent ring system was an improvement over the procedure of W. Steinkopf and H. F. Schmitt, *Ann.*, 533, 264 (1938), which started with o-mercaptobenzoic acid and 3-iodothiophene. The reactions of cuprous 3-thienylmercaptide with the previously mentioned methyl o-iodobenzoates afforded the sulfides in consistently good yields and clean reactions and eliminated the vagaries of metallic copper catalysis encountered in reactions of 3-thiophenethiol or silver 3-thienylmercaptide with various o-halobenzoic acids.

Various derivatives were prepared. The acids (III, Z = NO<sub>2</sub>; 4-Cl; H) were oxidized by hydrogen peroxide in glacial acetic acid to the corresponding sulfones (VI). The

thieno[3,2-b]thiachromones (IV, Z = NO<sub>2</sub>; 6-Cl; H) were oxidized by hydrogen peroxide in large excess in glacial acetic acid to the corresponding thieno[3,2-b]thiachromone-4-dioxides (VII). The structure of the parent sulfone (VII, Z = H) was proved in an independent synthesis by the cyclization of the acid chloride of *o*-(3-thienylsulfonyl)benzoic acid (VI, Z = H) with stannic chloride. The structures of the sulfones (VII, Z = NO<sub>2</sub>) were adduced from their infrared spectra which showed absorption in both the sulfone and thiophene regions and a pronounced carbonyl shift to higher frequencies (as compared with their precursors). The amines (V) were acetylated with acetic anhydride, the 7-amino isomer was condensed with 2-diethylaminoethyl chloride to the diamine (IV, Z = 7-Et<sub>2</sub>NCH<sub>2</sub>CH<sub>2</sub>NH), and the 7-nitrosulfone (VII, Z = 7-NO<sub>2</sub>) was reduced by stannous chloride to the amino compound (VII, Z = 7-NH<sub>2</sub>).

Microfilm \$2.95; Xerox \$10.00. 225 pages.

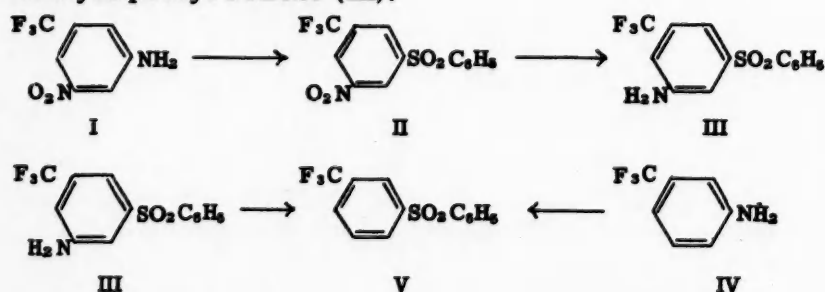
### 3-AMINO-5-TRIFLUOROMETHYLDIPHENYL SULFONE, SYNTHESIS AND PROOF OF STRUCTURE

(L. C. Card No. Mic 58-3036)

C. Richard Bresson, Ph.D.  
State College of Washington, 1958

The objective of this study was the synthesis of 3-amino-5-trifluoromethyldiphenyl sulfone (III), for comparison of its basic properties with those of two isomeric amino sulfones (2-amino-5-trifluoromethyldiphenyl sulfone and 4-amino-2-trifluoromethyldiphenyl sulfone), which had been prepared previously.

The natures and positions of the substituent groups in III precluded the use of obvious methods of preparation, viz., through the use of activated aryl halides as starting materials. Recourse was made to a little-used sulfide procedure developed by Ziegler. The diazonium salt of 3-amino-5-nitrobenzotrifluoride (I) was allowed to react with potassium thiophenolate, and then, by hydrogen peroxide oxidation, 3-nitro-5-trifluoromethyldiphenyl sulfone (II) was obtained; reduction of II gave 3-amino-5-trifluoromethyldiphenyl sulfone (III).



The structure of III was established by the synthesis of 3-trifluoromethyldiphenyl sulfone (V) [by the Ziegler method with subsequent oxidation] from *m*-trifluoromethylaniline; deamination of the amino sulfone III gave compound V also. The melting points and infrared spectra of 3-trifluoromethyldiphenyl sulfone (V), prepared by the two methods, were identical.

The following new compounds were prepared as intermediates in other attempts to synthesize and to prove the structure of III: 3-nitro-5-trifluoromethylsulfonamide,

3-nitro-5-methyldiphenyl sulfone, 3-nitro-5-carboxydiphenyl sulfone, and 2-amino-4-carboxydiphenyl sulfone.  
Microfilm \$2.00; Xerox \$3.00. 38 pages.

### THE GRIGNARD REACTION OF ORGANIC AZIDES

(L. C. Card No. Mic 58-3644)

Leonard Bretz Bruner, Jr., Ph.D.  
University of Michigan, 1958

The course of the reaction of alkyl and aryl Grignard reagents with alkyl, aryl, carbonyl, and sulfonyl azides has been examined. A review of the work of earlier investigators and new experimental work by the author indicate that the organic group from the Grignard reagent becomes attached to the terminal nitrogen of the azido group. The immediate product of this reaction appears to be the anion of a 1,3-disubstituted triazene.

Depending on the circumstances, this anion will either decompose or be converted to the triazene proper. The linear -N=N-N- chain of the triazene or anion seems subject to heterolytic scission which produces an amino or amido group and a diazonium ion. Strongly polarizing influences, either external (in the form of ionic materials) or internal (in the form of substituent groups), seem to promote this cleavage. This observation would be expected for a process of heterolytic cleavage. On the other hand, if the only diazonium ions which would logically be produced from the -N=N-N- chain scission are aromatic, the resultant triazene system is relatively stable. This suggests an equilibrium situation where the stability of the small amount of diazonium ion present at equilibrium determines the final result.

The principal products of the reaction of an alkyl Grignard reagent with a sulfonyl azide are the corresponding sulfonamide, nitrogen, and a complex mixture of high molecular weight materials. By contrast, the reaction of an aryl Grignard reagent with a sulfonyl azide can be made to produce a good yield of the corresponding aryl azide, or with reduction in situ, the aryl amine. This affords a new direct route from aromatic halides to the corresponding aromatic azides or amines.

In the pursuit of the major body of this work, it was found that tetrahydrofuran and 2-methyltetrahydrofuran are superior solvents for the preparation of many aromatic Grignard reagent solutions; the preparations are cleaner, faster, and give more concentrated solutions than the corresponding preparations in ether.

Use of the azide-olefin reaction as a means of characterizing azides or detecting azides as components in mixtures led to these observations. The best yields of adduct were obtained by maintaining the reaction mixture at room temperature. Higher temperatures resulted in lower yields and the formation of more by-products. *p*-Toluene-sulfonyl azide reacted with certain olefins with the loss of nitrogen at room temperature. This contrasts with the behavior of aromatic azides which form adducts with the bicyclic olefins, the adducts being stable to well over 100°C. The smoothness of this nitrogen evolution suggests that sulfonyl azides might be useful as quantitative

analytical reagents for certain active olefinic materials. Microfilm \$2.00; Xerox \$7.20. 153 pages.

4-SUBSTITUTED-1,5-DIPHENYL-  
3-HYDROXY- $\Delta^3$ -2-PYRROLINONES

(L. C. Card No. Mic 58-3648)

Irene Mabel Shuster Covey, Ph.D.  
University of Michigan, 1958

In order to obtain and prove the structure of 1,5-diphenyl-2,3-pyrrolidinedione, the hydrolysis of 4-carbethoxy- and 4-carbomethoxy-1,5-diphenyl-3-hydroxy- $\Delta^3$ -2-pyrrolinones was investigated. It was found that although they could not be hydrolyzed by the usual methods of ester cleavage, they could be decarbalkoxylated by refluxing in moist nitrobenzene. The compound obtained in this reaction was unlike that previously reported to be 1,5-diphenyl-2,3-pyrrolidinedione, which had been obtained from the condensation of pyruvic acid and benzylideneaniline, and it proved to be identical with authentic 1,5-diphenyl-2,3-pyrrolidinedione recently prepared in these laboratories by W. L. Meyer.

By a Michael type condensation of appropriately substituted oxalacetic esters and benzylideneaniline, 4-ethyl-, 4-methyl- and 4-benzyl-4-carbethoxy-1,5-diphenyl-2,3-pyrrolidinediones were prepared. Basic hydrolysis of these compounds then gave the corresponding 4-substituted-1,5-diphenyl-2,3-pyrrolidinediones. These compounds, however, have been shown to exist in the enol form as 3-hydroxy- $\Delta^3$ -pyrrolinones.

Condensation of appropriately substituted pyruvic acids with benzylideneaniline was also used to prepare certain of these 4-substituted compounds, namely 4-ethyl-, 4-benzyl- and the 4-phenyl-3-hydroxy- $\Delta^3$ -2-pyrrolinone. Thus, unlike pyruvic acid itself, substituted pyruvic acids condense with benzylideneaniline to give 2,3-pyrrolidinediones in the form of their tautomers, the 3-hydroxy- $\Delta^3$ -pyrrolinones.

When 4-phenyl- and 4-benzyl-3-hydroxy- $\Delta^3$ -2-pyrrolinones were heated above their melting points, they decomposed into carbon monoxide and 2,3-disubstituted-4-hydroxyquinolines. The 4-methyl and the 4-ethyl compounds when subjected to this same treatment, did not decompose.

The preparations and physical properties of the acetates and phenylamino (enamine) derivatives of 4-methyl-, 4-benzyl-, 4-ethyl- and 4-phenyl-1,5-diphenyl-3-hydroxy- $\Delta^3$ -2-pyrrolinones are described.

1,5-Diphenyl-2,3-pyrrolidinedione appears to dimerize under acidic or basic conditions – a property not exhibited by its 4-substituted derivatives.

Microfilm \$2.00; Xerox \$3.80. 69 pages.

A STUDY OF THE THIOCYANATE MECHANISM  
OF THE ISOTHIOCYANATE REARRANGEMENT

(L. C. Card No. Mic 58-3658)

David Winthrop Emerson, Ph.D.  
University of Michigan, 1957

The isomerization of alkyl thiocyanates, R-SCN, to isothiocyanates, R-NCS, has been studied with compounds having the groups allyl,  $\beta$ -methallyl, *n*-butyl, *sec*-butyl, *ter*-butyl,  $\alpha$ -phenylethyl, benzyl, and cinnamyl.

When the first two groups, a kinetic study was made, using the reaction of isothiocyanates with butylamine as an analytical method for the extent of isomerization. The isomerization was found to be first order, and to be little influenced by the polarity of the solvent. The change of the rate-constants over the temperature range 57.8 to 86.4° was found to correspond to activation energies of  $23.8 \pm 0.2$  k cal./mole for allyl thiocyanate, and  $24.4 \pm 0.2$  for  $\beta$ -methallyl thiocyanate, and entropies of activation of -9.4 and -8.7 e.u., respectively. Attempts to intercept possible carbonium ion intermediates with tri-*n*-butylamine gave evidence for their absence in kinetically significant quantities. This evidence is concluded to imply an intramolecular isomerization with a cyclic transition state.

The other thiocyanates, with the exception of cinnamyl, were resistant to isomerization without a catalyst. Zinc chloride was an effective catalyst, but it caused in addition so much tar formation that meaningful kinetic measurements could not be made. Qualitatively, however, it became clear that the ease of the isomerization is in order primary < secondary < tertiary for the butyl compounds, and that  $\alpha$ -phenylethyl isomerized most readily of all. Interception experiments with tertiary amines or phenol as the intercepting agent showed that carbonium ion intermediates were produced in important amounts. The isomerization of cinnamyl thiocyanate (to give cinnamyl, not  $\alpha$ -phenylvinyl, isothiocyanate) was not a clean enough reaction to allow accurate kinetic measurements, but the qualitative results obtainable showed that the reaction was hastened by increase in the polarity of the solvent. It is concluded that for these groups, an ionization path, giving rise to intermediate carbonium ions, is followed.

Microfilm \$2.00; Xerox \$4.40. 83 pages.

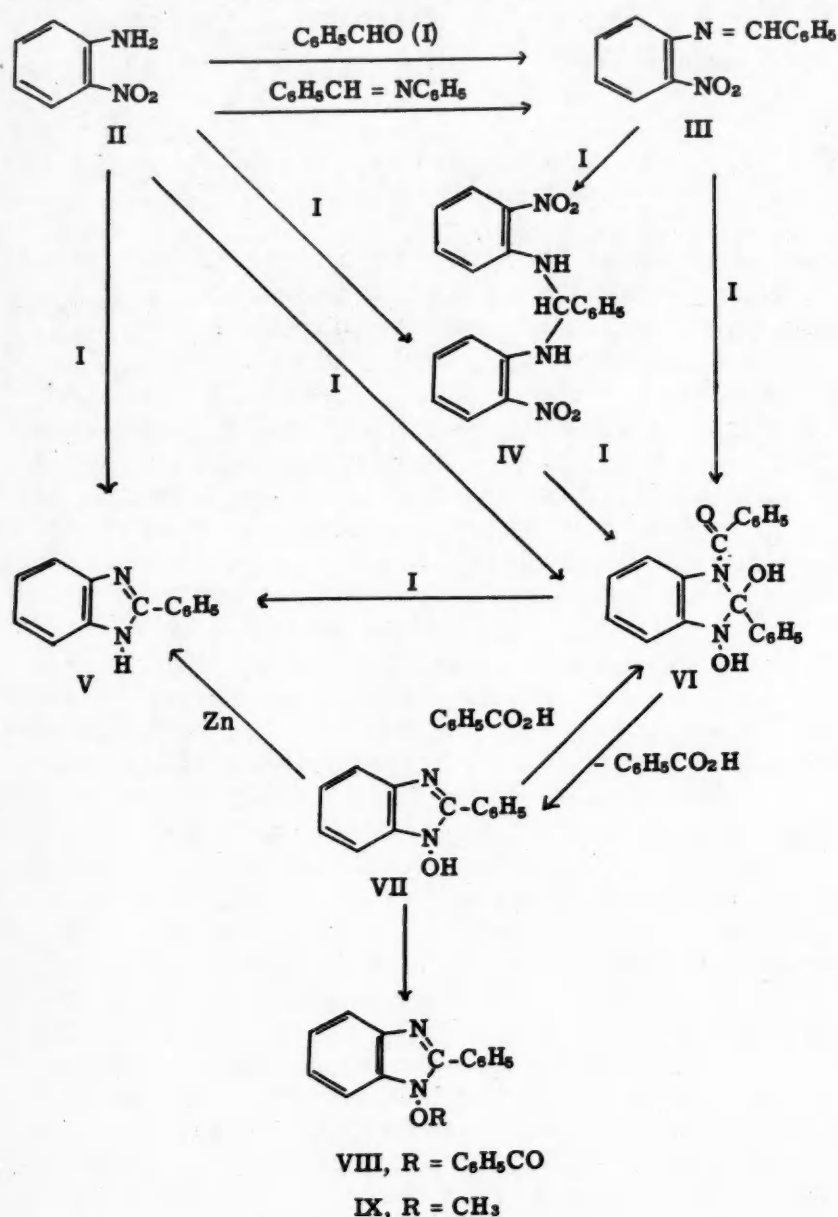
THE REACTIONS OF *o*-NITROANILINE  
WITH BENZALDEHYDE

(L. C. Card No. Mic 58-3038)

Bruce Vincent Ettling, Ph.D.  
State College of Washington, 1958

In connection with an investigation of the reactions of Schiff bases, *N*-benzylidene-*o*-nitroaniline (III) was desired. Condensation of benzaldehyde (I) with *o*-nitroaniline (II) gave a product (IV) (m.p. 118-120°), which had the same melting point as given in the literature<sup>1</sup> for III, but its composition was not in agreement with that required for III. Further heating of I and II gave a product (VI) (m. p. 183-184°); it could not be hydrolysed to I and II, and it was soluble in dilute sodium hydroxide solution.

At higher temperature and on longer heating, I and II gave still another product (V) (m. p. 292-294°); this could



not be hydrolysed; and it was soluble in dilute hydrochloric acid. Analysis, melting point, and melting point of the hydrochloride of V were in agreement with those for 2-phenylbenzimidazole<sup>2</sup> (mixed m. p. 293-294°). The formation of V involves reduction of the nitro group of II to an amino group and condensation of the reduction product with a mole of benzoic acid, which is formed by the oxidation of benzaldehyde.

Compound VI was soluble in alkali, but upon neutralization, another compound (VII) (m. p. 218-220°) and benzoic acid were found. Treatment of VI with sodium methoxide afforded the same products. Compound VII (1-hydroxy-2-phenylbenzimidazole) was base-soluble and could be reduced to V by heating it with zinc dust. Derivatives of VII [1-benzoxy-2-phenylbenzimidazole (VIII) and 1-methoxy-2-phenylbenzimidazole (IX)] were prepared; this demonstrated the presence of hydroxyl group. When VII was heated with benzoic acid, VI was regenerated.

The infrared spectrum of VI (1,2-dihydroxy-2-phenyl-3-benzoylbenzimidazoline) had a band characteristic of an amide group ( $1661\text{ cm}^{-1}$ ), but there was no band characteristic of an ester group. Because of the facile interconversion of VII and VI, it has been concluded that the latter involved the addition of benzoyl and hydroxyl groups to the double bond of VII. Compounds VI and VII are both photosensitive; this supports the N-arylhydroxylamine structures which have been postulated for them. Heating VI with benzaldehyde gave V.

Compound IV [N, N-benzylidenedi(o-nitroaniline)] was formed by the addition of a mole of II to the Schiff base III. Analysis and the absence of a band in the infrared spectrum characteristic of a carbon-nitrogen double bond support the diamino structure assigned to this compound. The melting point of IV was variable depending upon the solvent from which it was crystallized: chloroform-diisopropyl ether, m.p. 118-120°; benzene, m.p. 120-125°; chloroform-methanol, m. p. 165-172°.

Compound III (m. p. 76-78°) was prepared by direct condensation of I and II and by an amine exchange reaction between N-benzylideneaniline and II. Both III and IV were converted to VI when they were heated with I.

Compounds III and IV were formed in the initial steps of the reaction between I and II. Further heating of III or IV, in the presence of I, reduced the nitro groups to the hydroxylamine derivative (VI), and continued heating of VI in the presence of I gave the o-phenylenediamine derivative V. Microfilm \$2.00; Xerox \$3.00. 40 pages.

1. C. K. Ingold and H. Piggot, J. Chem. Soc., 121, 2804 (1922).
2. K. von Awvers and F. von Meyenburg, Ber., 24, 2386 (1891); H. Franzen, Ber., 40, 911 (1907).

## THE DECOMPOSITION OF SULFINIC ACIDS

(L. C. Card No. Mic 58-2867)

**John J. Godfrey, Ph.D.**

**Polytechnic Institute of Brooklyn, 1958**

Adviser: Charles G. Overberger

The mechanism of the decomposition of sulfinic acids was studied in both methyl methacrylate and non-polymerizable media with the object of determining the nature of the initiation process for sulfinic acid initiated polymerization of vinyl monomers. The dilatometer and the high vacuum system used to charge it with pure sulfinic acid and methyl methacrylate under high vacuum are described.

The rate of benzenesulfinic acid initiated polymerization at 20 and 30 varied from sample to sample of the sulfinic acid. Since sulfonic acid was shown to accelerate the rate of polymerization when present in a small mole fraction of the sulfinic acid, the variation in rate was suggested to be due to traces of the sulfonic acid formed by autoxidation of the sulfinic acid during handling. The rate of polymerization versus concentration of benzenesulfinic acid showed that the apparent order of the rate of polymerization with respect to the sulfinic acid increased with increasing sulfinic acid concentration from a minimum of approximately 1 and approached  $3/2$ . This is consistent with an initiation process of kinetic order between 2 and 3. An attempt to determine the order with respect to monomer by dilution of the methyl methacrylate with benzene unexpectedly resulted in an increase in the rate of polymerization. This effect was attributed to an increase in hydrogen bonding between sulfinic acid molecules upon dilution of the methyl methacrylate with benzene.

p-Methoxybenzenesulfinic acid was a more effective initiator of methyl methacrylate polymerization than the

unsubstituted benzenesulfinic acid. The order of the rate of polymerization with respect to the p-methoxybenzenesulfinic acid was 3/2 and did not vary with concentration. p-Trifluoromethylbenzenesulfinic acid was a correspondingly poor initiator; the order of the rate of polymerization with respect to this initiator was approximately 1. The rate of polymerization of methyl methacrylate initiated by an equimolar mixture of p-trifluoromethylbenzenesulfinic acid and p-methoxybenzenesulfinic acid showed that the p-methoxy compound preferred to react with itself; the absence of a large acceleration in rate of polymerization indicated the absence of a disproportionation reaction in the rate determining step.

The relationship between the reciprocal of the number average degree of polymerization and the rate of polymerization for sulfinic acid initiated polymerization of methyl methacrylate did not correspond with similar data for azonitrile or peroxide initiated polymerization; at increasing rates of polymerization the number average degree of polymerization remained unusually large. It was shown, however, by copolymerization of methyl methacrylate and p-chlorostyrene that the propagating chain in sulfinic acid initiated copolymerization is a free radical.

The sulfinic acid initiated polymerization of methyl methacrylate was accelerated by sulfonic acid, benzoyl peroxide, dicumyl peroxide, and di-n-butylamine hydrochloride.

Decomposition of the very unstable 2,2'-biphenyldisulfinic acid via a disproportionation to the intramolecular sulfonic acid-sulfenic acid was shown to be incompatible with the yield and rate of formation of the thiolsulfonate. The gross features of a mechanism consistent with the polymerization data were proposed.

Microfilm \$2.00; Xerox \$7.20. 152 pages.

#### THE STRUCTURE OF 8-HYDROXYSPARTALUPINE, AN ALKALOIDAL CONSTITUENT OF LUPINUS SERICEUS PURSH

(L. C. Card No. Mic 58-2911)

Stanley Irwin Goldberg, Ph.D.  
Indiana University, 1958

In addition to the main alkaloid, spartalupine,  $C_{15}H_{26}N_2$ , which E. W. Martin found in the Rocky Mountain lupine, Lupinus sericeus Pursh, a minor alkaloid was isolated which had the composition,  $C_{15}H_{26}N_2O$  or  $C_{15}H_{24}N_2O$ , and which melted at 103.5-104.5°C. The present investigation was concerned with the determination of the structure of this minor alkaloid. It was shown to be (-)-8-hydroxyspartalupine, not previously described in the literature.

Analysis of the base and two salts established the molecular formula as  $C_{15}H_{26}N_2O$ , and infrared absorption showed the presence of a hydroxyl group. The preparation and characterization of an acetyl derivative,  $C_{17}H_{28}N_2O_2$ , supplied the chemical proof of the presence of the hydroxyl group.

The chemical reactivity of the hydroxyl group was found to be very much less than in some other known hydroxy bases of the sparteine family of alkaloids, and consequently the removal of the hydroxyl function was unexpectedly difficult. The replacement of the oxygen function

with hydrogen was finally achieved, however, by a two-stage method. The first stage consisted of the replacement of the hydroxyl function with an iodo group through the action of triphenyl phosphite methiodide. The iodo intermediate was then treated with lithium aluminum hydride - a process which replaced the iodo group with hydrogen, and yielded the unsubstituted carbon-nitrogen skeleton of the original base.

The identification of the desoxy reaction product established that the skeletal structure of the hydroxy alkaloid is the same as that of the major alkaloid, spartalupine, including the stereochemical configuration.

The hydroxyl group of the alkaloid could not be removed by treatment with lithium aluminum hydride, nor could it be eliminated as water to form an unsaturated product. These experimental observations and the fact that the hydroxyl group is replaceable only under rather special conditions, led to the tentative assignment of the 8-methylene bridge as the location of the hydroxyl group.

The final assignment of structure was achieved by inversion of two of the asymmetric centers in the molecule by chemical dehydrogenation with mercuric acetate, followed by stereospecific rehydrogenation. This procedure yielded a diastereoisomeric base which was compared with synthetic (+)-8-hydroxy- $\alpha$ -isoparteine, recently prepared by C. L. Schöpf and co-workers. Identical infrared spectra, identical chromatographic behavior (i.e., equal  $R_f$  values), and similar unusual chemical reactivity established the relationship of the optically active base derived from the naturally occurring alkaloid to Schöpf's synthetic racemic base.

The chemistry and biogenetic significance of the compounds is also discussed.

Microfilm \$2.00; Xerox \$5.80. 116 pages.

#### THE TRIMERIZATION OF ALDEHYDES

(L. C. Card No. Mic 58-2843)

George Neal Grammer, Ph.D.  
Louisiana State University, 1958

Supervisor: Professor J. L. E. Erickson

The spontaneous polymerization of phenylacetaldehyde. - It is known that phenylacetaldehyde, if allowed to stand for a period of several months, gradually becomes increasingly viscous and finally deposits a crystalline substance which has a molecular weight corresponding to that of a trimer of phenylacetaldehyde. It has been assumed that this behavior is due to polymerization processes. Since neither the structure of the crystalline substance nor the nature of the polymerization process has been established, the need for further experimental study to explain the so-called spontaneous polymerization of phenylacetaldehyde initiated this investigation.

The crystalline trimer, m.p. 114.5-115°, was obtained by allowing freshly distilled phenylacetaldehyde to stand at room temperature for eight to ten months. It was found, however, that the rate of formation of this substance was greatly accelerated by the presence of a catalytic amount of alcoholic potassium hydroxide, so that satisfactory yields were obtained within five to seven days. The trimer

yielded a mono-acetate and a mono-benzoate, and its infrared spectrum showed characteristic bands for hydroxyl and ether absorption. Its formation by a base-catalyzed process suggested that an aldol condensation had produced phenylacetaldol, which then combined with another molecule of phenylacetaldehyde to yield a cyclic sesquiacetal, 2,4-dibenzyl-5-phenyl-6-hydroxy-1,3-dioxane. The proposed structure was confirmed by reducing the trimer with zinc and hydrochloric acid to yield a cyclic acetal, 2,4-dibenzyl-5-phenyl-1,3-dioxane, which was also prepared for comparison by condensing 2,4-diphenyl-1,3-butanediol with phenylacetaldehyde dimethylacetal. The trimer, upon treatment with lithium aluminum hydride or by catalytic hydrogenation, yielded  $\beta$ -phenylethyl alcohol and 2,4-diphenyl-1,3-butanediol, the reduction product of phenylacetaldol. Distillation of the trimer at reduced pressures yielded nearly the theoretical quantities of phenylacetaldehyde and either phenylacetaldol or its dehydration product  $\alpha$ , $\gamma$ -diphenylcrotonaldehyde.

The viscous oil obtained as a result of the polymerization of phenylacetaldehyde gave an infrared spectrum which was almost identical with that of a saturated solution of the trimer in freshly distilled phenylacetaldehyde. These results suggested that polymerization resulted principally in an equilibrium mixture of phenylacetaldehyde, phenylacetaldol, and 2,4-dibenzyl-5-phenyl-6-hydroxy-1,3-dioxane.

The base-catalyzed trimerization of aliphatic aldehydes. - It is known that isobutyraldehyde undergoes a base-catalyzed reaction to form a trimer, which has been assigned the structure, 2,4-diisopropyl-5,5-dimethyl-6-hydroxy-1,3-dioxane. The present results confirm this structure conclusively.

The trimer of isobutyraldehyde was converted into 2,4-diisopropyl-5,5-dimethyl-6-chloro-1,3-dioxane. This chloride was reduced to a cyclic acetal, 2,4-diisopropyl-5,5-dimethyl-1,3-dioxane, which was prepared independently by the condensation of isobutyraldehyde with 2,2,4-trimethyl-1,3-pentanediol.

The trimers of octanal, nonanal, decanal, undecanal and lauraldehyde were prepared for the first time by the base-catalyzed trimerization process. Molecular weights, analyses and infrared spectroscopic data supported the sesquiacetal-type structure. The unstable hexanal trimer was isolated in the form of its acetate.

Vinyl acetate reacted with the trimers of acetaldehyde, butyraldehyde and isobutyraldehyde to yield the corresponding acetates. The pyrolysis of acetates such as 2,4-dimethyl-6-acetoxy-1,3-dioxane seemed to offer a possible means of obtaining a series of new compounds having a 1,3-dioxene-type structure. 2,4-Dimethyl-6-acetoxy-1,3-dioxane was subjected to such treatment, but gave only acetic acid, acetaldehyde and crotonaldehyde. Similarly, 2,4-diethyl-5-methyl-6-acetoxy-1,3-dioxane suffered extensive decomposition and yielded acetic acid, propionaldehyde and 2-methyl-2-pentenal.

The acid-catalyzed trimerization of aliphatic normal aldehydes. - Aliphatic aldehydes undergo an acid-catalyzed reaction to yield trimers which have a 2,4,6-trialkyl-1,3,5-trioxane structure. A table showing the physical constants of all aliphatic normal aldehydes possessing from one to eighteen carbon atoms, and their corresponding trimers, has been carefully prepared. Two of these trimers (para-n-valeraldehyde and para-n-hexanal), as well as the melting points of four aldehydes (hexanal, octanal,

nonanal, decanal), have not been reported in the literature. Microfilm \$2.00; Xerox \$4.80. 91 pages.

# THE SYNTHESIS AND ACIDITIES OF 1,2,4,2H-THIADIAZINE-3,5(4H,6H)- DIONE-1,1-DIOXIDE AND ALKYL DERIVATIVES

(L. C. Card No. Mic 58-2966)

Bernard E. Hoogenboom, Ph.D.  
State University of Iowa, 1958

Chairman: Assistant Professor Richard D. Campbell

1,2,4,2H-Thiadiazine-3,5(4H,6H)-dione-1,1-dioxide(I) was prepared in a new and independent manner by the cyclization of carbamylmethanesulfonylurea(II) in the presence of refluxing anhydrous pyridine. This cyclization is believed to involve the formation of an intermediate sulfonylisocyanate, carbamylmethanesulfonylisocyanate. Carbamylmethanesulfonylurea(II) was obtained from sulfamylacetamide(III) by the action of potassium cyanate. Sulfamylacetamide(III) was, in turn, prepared by the ammonolysis of diphenyl sulfoacetate(IV) in the presence of liquid ammonia. In addition to the parent thiadiazine(I), its 4-methyl(V) and 6-methyl(VI) derivatives were prepared by the cyclization of the corresponding carbamylalkanesulfonylurea. Repeated attempts to prepare the 6,6-dimethyl derivative of the parent thiadiazine(I) in a similar manner were unsuccessful. A dihydro- derivative, 1,2,4,2H-thiadiazine-3(4H,5H,6H)-one-1,1-dioxide, was prepared by the cyclization of beta-sulfamylethylurea in refluxing anhydrous pyridine.

Diphenyl sulfoacetate(IV) was successfully methylated with methyl iodide in the presence of *tert*-butoxide base to form diphenyl alpha-sulfopropionate and diphenyl alpha-sulfoisobutyrate. In the presence of hydroxide or ethoxide bases, this alkylation is complicated by a cleavage of diphenyl sulfoacetate to form phenyl methanesulfonate.

By means of a series of selected reactions, it was demonstrated that carbamylmethanesulfonylurea(II), rather than the isomeric sulfamylacetylurea, is formed by the reaction of sulfamylacetamide(III) with potassium cyanate.

The apparent pKa value of the parent thiadiazine(I) at an ionic strength of  $1.6 \times 10^{-2} M$  was found to be 2.53. The apparent pKa values of the various thiadiazines and their immediate precursors at the same ionic strength and the strongly acidic nature of the parent thiadiazine(I) suggest that the dissociating species of the thiadiazine is an enol form involving the 5,6- position; the dissociating species of the 4-methylthiadiazine(V) and the 6-methylthiadiazine(VI) are enolic forms of a similar structure. On the basis of the number of resonance forms possible for each structure, the proposed mono-enolic forms are expected to be more stable than the keto forms or any other conceivable mono-enolic forms of the thiadiazines(I,V,VI). In as much as barbituric acid is believed to exist in a mono-enolic form in both the solid state and in neutral aqueous solution, it is reasonable to suggest that the thiadiazine(I) and its 4-(V) and 6-(VI) methyl derivatives also exist in a mono-enolic form in both the solid state and in neutral aqueous solution. Microfilm \$2.00; Xerox \$7.00. 146 pages.

# THE CHEMISTRY OF ACRIDIZINIUM SALTS

(L. C. Card No. Mic 58-2736)

James Holden Jones, Ph.D.  
Duke University, 1958

Supervisor: Charles K. Bradsher

It has been shown that certain acridizinium (benze[b]-quinolizinium) salts, when treated with nucleophilic reagents, yield additions products in which the base has added to carbon number six. The basic entities which reacted were: ethereal phenylmagnesium bromide, aqueous potassium cyanide; and acetone, acetophenone and phenylacetonitrile in alkaline ethanol. Oxidation of the compound isolated from the reaction of phenylmagnesium bromide with acridizinium bromide yielded 2-( $\alpha$ -picolinyl)-benzophenone, establishing carbon six as the reactive site for nucleophilic attack. The 6-phenyl and 6-cyano addition products were dehydrogenated to the fully aromatic acridizinium salts but the other compounds were isolated as the 5,6-dihydro salts.

When yellow crystalline acridizinium bromide is exposed to sunlight for several hours, it yields a sparingly soluble, high-melting product which, when pure, is colorless and nonfluorescent. A formula has been prepared for this irradiation product which represents it as having dimerized across the 6,11-positions. This structure accounts for the ultra-violet spectrum of the compound and also for the results obtained from molecular weight determinations.

By hydrochloric acid catalyzed cyclodehydration of the salts formed from pyridine-2-aldehyde with various alkoxybenzyl bromides, five new alkoxyacridizinium salts were prepared. The intermediate quaternary salts were made by refluxing pyridine-2-aldehyde and the proper alkoxybenzyl bromide in absolute methanol for only a few hours. In the cyclization, the hydrochloric acid held ether cleavage to a minimum and provided the alkoxyacridizinium salts in reasonably good yields. The compounds prepared were: 8-methoxy, 62%; 8-hydroxy (by hydrobromic acid cyclization), 37%; 7,8-dimethoxy, 75%; 8,9-methylenedioxy, 31%; and 7,8-methylenedioxy, 42%.

When 1-isoquinoline aldehyde was substituted for pyridine-2-aldehyde in the reactions with the benzyl bromides, and cyclization was carried out as before, several new benzo[a]acridizinium salts were obtained. These compounds are structurally similar to the berberine alkaloids and, in fact, the compound benzo[a]acridizinium bromide could be considered the aromatic parent compound of the protoberberinium salts. The substituted benzo[a]acridizinium salts prepared in this manner were: 10-methoxy, 78%; 9,10-dimethoxy, 53%; 9,10-methylenedioxy, 66%; and benzo[a]acridizinium bromide itself, 52%.

When certain 2-alkoxybenzylpyridines were dissolved in acetic anhydride containing a little sulfuric acid and this solution was heated several hours, acylation and cyclization both occurred and the corresponding 6-methylalkoxyacridizinium salts resulted. The compounds prepared in this manner were: 6-methyl-8,9-dimethoxy, 31%; 6-methyl-8,9-diethoxy, 74%; 6-ethyl-8,9-diethoxy, 48%; 6-methyl-8,9-methylenedioxy, 25%. It was felt that cyclization was indicated because the ultra-violet spectra showed the three absorption peaks in the near-visible region which are characteristic of the highly conjugated acridizinium ion.

Three other new acridizinium salts were prepared using the normal acid-catalyzed cyclodehydration procedure on the corresponding quaternary salts. The compounds prepared were: 4-methyl, 2.5%; 9-chloro, 17%; and 9-bromoethyl, 29%. Microfilm \$2.00; Xerox \$5.20. 101 pages.

# ADDITION REACTIONS OF CHLORINE, IODINE, AND IODINE CHLORIDE

(L. C. Card No. Mic 58-2972)

Donald Fred Knaack, Ph.D.  
State University of Iowa, 1958

Chairman: Dr. Robert E. Buckles

The addition of chlorine, iodine, and iodine chloride to the multiple bonds of various unsaturated organic molecules was investigated. Also it was of interest to see if the additions of these halogens were stereospecific.

When tetra-n-butylammonium iodotetrachloride was used as a chlorinating agent, the addition of chlorine to the stilbenes was stereospecific. However, it was found that the reactions of cis- and trans-stilbene with chlorine, and with chlorine in the presence of other reagents (i.e. tetra-n-butylammonium chloride and antimony pentachloride) were not stereospecific. In these cases, the most stable isomer, which is meso- $\alpha,\alpha'$ -dichlorobibenzyl, was usually formed predominately. The reaction of tetraphenylethylene with tetra-n-butylammonium iodotetrachloride in the dark produced only one isomer of 1,2-dichloro-1,1,2,2-tetraphenylethane. The synthesis of 1,2-dichloro-1,1,2,2-tetrakis(3,5-dichloro-4-methoxyphenyl) ethane was accomplished by allowing chlorine and tetrakis(p-methoxyphenyl) ethane to react in the dark. The elimination of chlorine from 1,2-dichloro-1,1,2,2-tetrakis(3,5-dichloro-4-methoxyphenyl) ethane with zinc dust produced a new compound, tetrakis(3,5-dichloro-4-methoxyphenyl) ethylene. The reaction of styrene and tetra-n-butylammonium iodotetrachloride in the dark produced 1,2-dichloro-1-phenylethane. Impure 2,4,6-trichlorophenol was formed in the reaction of phenol and tetra-n-butylammonium iodotetrachloride.

Iodine chloride was synthesized by the reaction of iodine with chlorine. The addition of iodine chloride to styrene gave 2-iodo-1-chloro-1-phenylethane. The structure of this iododichloride was established by dehydrohalogenation. The method used was developed into a laboratory experiment for organic chemistry classes. The reaction of trans-stilbene and iodine chloride in the dark produced erythro- $\alpha$ -chloro- $\alpha'$ -iodobibenzyl. This erythro compound was characterized by dehalogenation to trans-stilbene. The reaction of cis-stilbene and iodine chloride did not produce the expected threo- $\alpha$ -chloro- $\alpha'$ -iodobibenzyl. Instead dl- $\alpha,\alpha'$ -diiodobibenzyl and a small amount of meso- $\alpha,\alpha'$ -dichlorobibenzyl was obtained. The addition of iodine chloride to tolan gave trans- $\alpha$ -chloro- $\alpha'$ -iodostilbene in good yield. This compound was characterized by the trans elimination of halogen to give tolan. The reaction of iodine chloride with indene yielded a small amount of impure product which might have been 2-chloro-3-iodoindan or 2-iodo-3-chloroindan. The addition of iodine chloride to cyclohexene produced 1-chloro-2-iodocyclohexane. When trans-cinnamic acid was treated with iodine chloride,

$\alpha$ -iodo- $\beta$ -chlorohydrocinnamic acid was formed. Oils were produced when iodine chloride reacted with trans-crotonic, angelic, and tiglic acids. Attempts to add iodine chloride to fumaric acid were unsuccessful.

Halogens, organic halides, and starting materials were analyzed by gas chromatography in connection with the halogenation experiments.

Microfilm \$2.00; Xerox \$6.40. 132 pages.

# THE SUBSTITUENT EFFECT IN THE REACTIONS OF A GROUP ATTACHED TO THE CYCLOHEXANE RING

(L. C. Card No. Mic 58-2753)

Julius M. Komarmy, Ph.D.  
University of Arkansas, 1958

Major Professor: Samuel Siegel

The dissociation constants of a series of trans 4-X-cyclohexanecarboxylic acids (X = -H, -OH, -OCH<sub>3</sub>, -Cl, -CO<sub>2</sub>H, -CN, = O) have been measured in water and two mixed solvents at 25°C. The rate of reaction of these acids with diphenyldiazomethane and the rate of alkaline hydrolysis of the methyl esters in 50% aqueous methanol were also determined, the latter at three temperatures.

Variation of the substituent group shows a substantial influence on the reactivity of the trans 4-substituted cyclohexanecarboxylic acids and their esters. These data are correlated by an equation similar to that of Hammett (1) e.g.

$$\log k/k_0 = \rho''\sigma''$$

where k and k<sub>0</sub> refer to the rate or equilibrium constants for the reactions of the substituted and the unsubstituted reactant,  $\rho''$  is a constant characteristic of the reaction and  $\sigma''$  is characteristic of the substituent.

The correlations obtained are of interest because few aliphatic systems demonstrate linear free energy relationships of this type. The substituent constants,  $\sigma''$ , obtained for the 4-substituted cyclohexanoic acids are well suited for a comparison with similar substituent constants,  $\sigma$ , determined for a series of para substituted benzoic acids. The size and shape of the molecules in the one series closely approximate the molecular dimensions of the second series. These parameters have an appreciable effect upon the energy relationships which arise from electrostatic factors.

The calculation of the relative dissociation constants of the acids using the Kirkwood-Westheimer (2,6) equations was moderately successful. Considering the approximations which must be made the agreement is reasonable. A calculation using the modification reported by Tanford (3, 4,5) provided values of the dissociation constants which are in good agreement with the experimental values.

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Microfilm \$2.00; Xerox \$5.20. 105 pages.

# THE REACTION OF POLYELECTROLYTE NUCLEOPHILES WITH BROMOACETIC ACID AND $\alpha$ -BROMOACETAMIDE

(L. C. Card No. Mic 58-2870)

Harry Ladenheim, Ph.D.  
Polytechnic Institute of Brooklyn, 1958

Adviser: Herbert Morawetz

The main object of this investigation was the demonstration, in a reaction of a synthetic polymer, of a neighboring-group effect such as is found in enzymatic reactions. The substrates used were bromoacetic acid and  $\alpha$ -bromoacetamide. The reactions, involving nucleophilic displacement on the carbon-bromine bond, were followed by potentiometric titration for bromide ion with silver nitrate.

In a study of quaternization of poly-4-vinylpyridine and bromoacetate ion, at a given degree of ionization of the polymer, the apparent rate constant falls sharply upon addition of salt. This effect is explained by the attenuation of the mutual attraction of the positively charged polymer and negative substrate. Furthermore, at a given salt concentration, the second order rate constant rises with increasing polymer charge. This effect was correlated with the increasing acid strength of the polymer, which shows the enhanced reactivity to be due to the electrostatic interaction of the polycation with the negative bromoacetate.

Reaction of  $\alpha$ -bromoacetamide with the polymer gave rate constants which depended little on its degree of ionization. In addition, the amide reacted at comparable rates with the neutralized polymer and its analogue, 4-methylpyridine, whereas the bromoacetate ion was attacked much faster by the positively charged polymer.

In a second system, the displacement of bromine by the carboxylate groups of partially neutralized polymethacrylic acid was followed. It was expected that an ionized carboxyl group of the polymer would attack the carbon-bromine bond while a second unionized carboxyl would form a hydrogen bond with the carboxylate of the bromoacetate, but it was found that the reaction rate was negligible, presumably due to strong electrostatic repulsion, even at a comparatively high salt concentration. In the reaction of polymethacrylic acid with  $\alpha$ -bromoacetamide, the reactivity of carboxylate groups increased sharply with decreasing ionization of the polymer.

To clarify the results obtained with the polymer, reactions of some dicarboxylic acids were investigated. It was found that the reaction of the substrate,  $\alpha$ -bromoacetamide, with the divalent maleate ion was seven times as large as with the monoanion. By contrast, with glutarate and fumarate ions, the carboxylate groups were found to react independently of each other. The result obtained with maleate was interpreted in terms of a stabilization of the

transition state due to hydrogen-bonding of the carboxylate and amide groups. The bromoacetate gave a negligible reaction with both maleate species. The results obtained with the dicarboxylic acids failed to clarify the reason for the increased reactivity of carboxylate groups in polymethacrylic acid at low degrees of ionization.

Poly-4-vinylpyridine betaine and 4-methylpyridine betaine reported for the first time, possess a carboxylate group which can attack the carbon-bromine bond of the two substrates. The polybetaine was less reactive with the amide than neutralized polymethacrylic acid. Bromoacetate had a reactivity similar to that of the amide. By contrast, the analogue gave no detectable reaction with either substrate.

The investigation demonstrated that reaction rates involving small molecules with polyelectrolytes may differ markedly from those of low molecular weight analogues. Only some of the effects are explicable on electrostatic grounds. Where such comparisons are possible, the apparent ionization constant of the polymer changes more rapidly with polymer charge than does the reaction rate with a charged substrate.

Microfilm \$2.00; Xerox \$5.40. 108 pages.

#### THE REACTIONS OF CERTAIN ACTIVE HYDROGEN COMPOUNDS WITH AROMATIC AND HETEROCYCLIC HALIDES

(L. C. Card No. Mic 58-2032)

William Walter Leake, Ph.D.  
University of Pittsburgh, 1958

For many years the organic chemist has alkylated active hydrogen compounds by treating their metallic derivatives with alkyl halides. However, only a few isolated examples of the arylation of carbanions with non-activated aryl halides appear in the literature.

The purpose of the present investigation is to develop a method for the direct phenylation of active hydrogen compounds with nonactivated phenyl halides using alkali amides as condensing agents.

Two procedures, the two-flask method and the one-flask method, were employed in the arylation reactions. In the two-flask method, the active hydrogen compound was converted to its anion by reaction with an equivalent of alkali amide in liquid ammonia and then the halobenzene (chloro- or bromo-benzene) was added. Excess alkali amide, which was suspended in liquid ammonia in a second flask, was then siphoned into the first flask, which contained the anion and the halobenzene. In the one-flask method, all the alkali amide which is to be used is present in the reactor before the active hydrogen compound and the halobenzene are added.

By these methods it has been possible to obtain fair-to-good yields of phenylated products using the following types of active hydrogen compounds: ketones, simple esters, malonic esters, nitriles, certain carboxylic acids, mercaptans, terminal acetylenes, certain tar bases, and methylpyrazine. The phenylation reaction failed with the typical hydroxy compounds, phenol, ethanol, and water.

It was found that alkali amide in excess of that which is necessary to convert the active hydrogen compound to its

anion must be used in order to phenylate all of the active hydrogen compounds which were studied with the exception of  $\alpha$ -picoline,  $\gamma$ -picoline, 2-ethylpyridine, and 4-ethylpyridine.

As a possible explanation for the course of the reaction it is suggested that the anions of most of the active hydrogen compounds add to an electrically neutral intermediate, benzyne, the dehydrohalogenated halobenzene. The function of the excess alkali amide is to dehydrohalogenate the halobenzene to the benzyne intermediate.

That the anions of  $\alpha$ -picoline,  $\gamma$ -picoline, 2-ethylpyridine, and 4-ethylpyridine give phenylated products by reaction with halobenzene even in the absence of excess alkali amide has been rationalized by suggesting that a complex is formed between each of the alkylpyridine anions and the halobenzene. The complex then rearranges to give the phenylated products.

Finally the method has been applied to the introduction of the pyridine ring into one active hydrogen compound. Thus, when 3-bromopyridine was added to a mixture of acetophenone and excess sodium amide in liquid ammonia, 4-phenacylpyridine and 4-aminopyridine were obtained and none of the expected 3-isomers was isolated. These results have been rationalized by assuming that pyridine, a pyridine analogue of benzyne, is formed and that sodioacetophenone and sodium amide then react with this intermediate.

Microfilm \$2.50; Xerox \$8.80. 191 pages.

#### THE DIMER OF 1,3-DIPHENYL-1,3-BUTADIENE

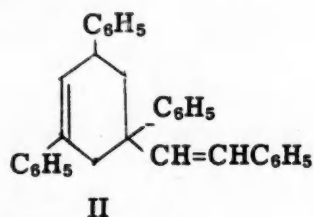
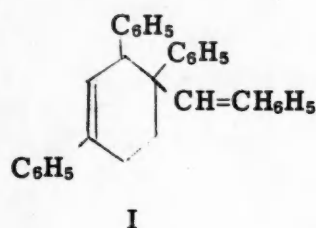
(L. C. Card No. Mic 58-2793)

George Edwin Lewis, Ph.D.  
The Florida State University, 1958

The dehydration of either 1,3-diphenyl-2-butene-1-ol or 1,3-diphenyl-1-butene-3-ol yields a dimer of 1,3-diphenyl-1,3-butadiene. Although 1,3-diphenyl-1,3-butadiene was never isolated from these dehydrations or from the addition of triphenylphosphine methylene to benzalacetophenone, it could be trapped successfully as a maleic anhydride adduct.

The structure of the dimer was deduced from the following evidence. The ultraviolet spectrum had an absorption maximum at  $252\text{ m}\mu$  ( $\log \epsilon 4.55$ ), and the infrared spectrum had a strong band at  $970\text{ cm}^{-1}$ . On microhydrogenation the dimer ( $\text{C}_{32}\text{H}_{28}$ ) absorbed two equivalents of hydrogen to give a  $\text{C}_{32}\text{H}_{32}$  compound. Oxidations of the dimer with either ozone or permanganate gave benzaldehyde, benzoic acid, and 1,2-dibenzoylthane, but no formaldehyde. Sulfur dehydrogenation gave 1,3,5-triphenylbenzene, whereas selenium dioxide or tetrachloro-o-benzoquinone gave a  $\text{C}_{32}\text{H}_{24}$  compound. This hydrocarbon was identified as 2,3,5-triphenylstilbene by oxidation to an acid which was decarboxylated to 1,2,4-triphenylbenzene. 1,2,4-Triphenylbenzene was prepared independently for comparison. Dehydrogenation of the tetrahydro derivative of the dimer with tetrachloro-o-benzoquinone gave a product which is believed to be 1,3,9-triphenylphenanthrene. This same product was formed from the dehydrogenation of a sample of 1-(2-phenylethyl)-2,4,6-triphenylbenzene which had been prepared from 2,4,6-triphenylbenzomobenzene by a series of standard reactions.

On the basis of the preceeding evidence only two structures for the dimer could be considered. The isolation of different products



from the dehydrogenation of the dimer and its tetrahydro derivative indicated that different groups had migrated in each of these aromatizations. The most reasonable interpretation is that a styryl group in the dimer has migrated to give 2,3,5-triphenylstilbene and that a phenyl group in the tetrahydro dimer has migrated to give 1-(2-phenylethyl)-2,4,6-triphenylbenzene. This interpretation requires the structure of the dimer to be 1,3,4-triphenyl-4-styrylcyclohexene(I). The styryl group in this molecule is *trans* from the infrared data. This structure further requires that a phenyl group has migrated during the sulfur dehydrogenation.

I is the product of the Diels-Alder dimerization of 1,3-diphenyl-1,3-butadiene that would be predicted on the basis of an ionic mechanism for this reaction. An interpretation of the mechanism of the Diels-Alder reaction is discussed in these terms. Microfilm \$2.00; Xerox \$5.40. 110 pages.

**PART I - CATIONIC POLYMERIZATION.  
PART II - ANIONIC POLYMERIZATION OF  
METHACRYLONITRILE WITH LITHIUM  
IN AMMONIA.**

(L. C. Card No. Mic 58-2874)

Eli M. Pearce, Ph.D.  
Polytechnic Institute of Brooklyn, 1958

Adviser: C. G. Overberger

It was of interest to determine the dependence of the molecular termination constant for p-xylene in the cationic polymerization of styrene with changes in temperature. Therefore, the molecular termination constants for p-xylene in the cationic polymerization of styrene were determined at 25°, 0° and -19±1° and were 0.0186, 0.0095 and 0.0023, respectively. The energy of activation for the molecular termination process was approximately 7 kcal/mole in agreement with that expected for a Friedel-Crafts reaction.

Previous research had shown that α-ethylstyrene did not homopolymerize with stannic chloride as the catalyst, and attempted copolymerizations with p-chlorostyrene gave irreproducible copolymer composition data. In an attempt to explain these phenomena, studies were carried out on the reaction of α-ethylstyrene with stannic chloride. Reaction of α-ethylstyrene with stannic chloride at 0° for 1 hour gave a mixture of dimer (78%) and trimers (16%). The dimer was characterized as 3,5-diphenyl-5-methyl-2-heptene. After 24 hour contact with catalyst, the cyclic dimer, 1,3-diethyl-1-methyl-3-phenylhydrindane (46%), was isolated. A suggestion is made for the lack of poly-

mer formation on the basis of steric factors. cis-α,β-Dimethylstyrene, after contact with stannic chloride for 24 hours, gave a mixture of dimers (31%) from which 3,5-diphenyl-5-methyl-2-heptene was characterized. trans-α,β-Dimethylstyrene did not react under these conditions.

In an attempt to correlate the size and location of alkyl groups on styrene with the extent of steric domination of their reactivities during cationic polymerization, a variety of nuclear and side-chain alkyl-substituted styrene monomers were copolymerized with a reference monomer. Monomer reactivity ratios are reported for the copolymerization of α-, β-, and p-alkyl styrenes with a reference monomer (p-chlorostyrene) and show the following order of reactivity: α-methyl > p-methyl > p-ethyl > styrene > trans-β-methyl > cis-β-methyl > β-ethyl. An interpretation of results in terms of steric factors, hyperconjugation and proximity to the reaction site is given.

Methacrylonitrile polymerized instantaneously and quantitatively with lithium in liquid ammonia at -75%. Previous investigators had suggested that the amide anion was responsible for the polymerization of styrene with potassium in ammonia. In order to elucidate the mechanism of initiation in the system lithium-methacrylonitrile-ammonia, kinetic studies were attempted. An increase in the methacrylonitrile concentration or a decrease in the lithium concentration with the other variable kept constant, increased the molecular weight of the polymer. A plot of  $1/\overline{DP}_n$  vs.  $1/[M]$  at constant catalyst concentration gave a straight line. In addition, the molecular weight of the polymer was proportional to  $[M]/[C]$ . No reduction products of methacrylonitrile were observed. It was therefore proposed that the initiation occurs by a one electron transfer from lithium to methacrylonitrile to give an ion radical with subsequent radical coupling to give a dianion as the propagating species. The yellow polymer showed significant infrared absorption peaks at 1675 cm<sup>-1</sup> and 1640 cm<sup>-1</sup> which was interpreted as indicating the presence of (-C=N-)x. A mechanism for the formation of (-C=N-)x is suggested.

Microfilm \$2.00; Xerox \$3.80. 66 pages.

**THE SYNTHESIS  
AND CHEMISTRY OF 2-SUBSTITUTED-5,  
6-DIHYDROIMIDAZO[ij]QUINOLINES AND  
CERTAIN RELATED COMPOUNDS**

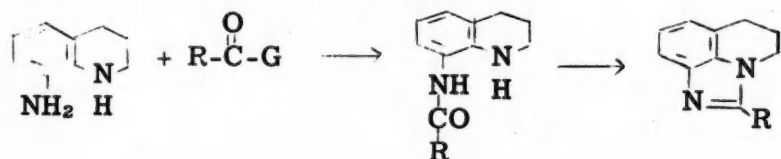
(L. C. Card No. Mic 58-3079)

Alfred Richardson, Jr., Ph.D.  
Lehigh University, 1958

Adviser: E. D. Amstutz

The 2-substituted-5,6-dihydroimidazo[ij]quinolines were synthesized by condensing 8-amino-1,2,3,4-tetrahydroquinoline with carbonyl reagents such as carboxylic acids (mono- and difunctional), esters, acid chlorides, and amides (difunctional). The carbonyl reagent was successfully condensed when R- was aliphatic, aliphatic containing oxygen or sulfur, aromatic, or heterocyclic. The reaction was most successful when R- was saturated aliphatic with or without the presence of oxygen or sulfur in the molecule.

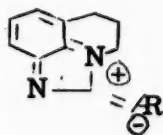
Neither unsaturated nor nitrogen-containing aliphatics would condense with 8-ATHQ. A steric effect was observed to be important when highly branched aliphatic acids would not condense under any conditions. Occasionally the normal product of reaction of 8-ATHQ and oxygen or sulfur-containing aliphatic acids was unstable and reacted further to give other products; thus,  $\beta$ -mercaptopropionic acid yielded bis-[2-(5,6-dihydroimidazo[*ij*]quinolyl)-ethyl] sulfide, and malic or thiomalic acid afforded 2,2'-vinylenebis-(5,6-dihydroimidazo[*ij*]quinoline).



When the acids or esters were aromatic, or  $\alpha,\beta$ -unsaturated, condensations did not occur. This indicated that the important step in the reaction was an attack of the carbonyl group by the 8-amino function (8-amido-THQ intermediates were sometimes isolated) of 8-ATHQ since R- groups capable of diminishing the carbonyl character of  $\text{RCO}_2\text{H}$  or  $\text{RCO}_2\text{R}'$  prevented condensation. When acid chlorides were employed ( $\text{G} = \text{Cl}$ ), condensation occurred readily regardless of the nature of R.

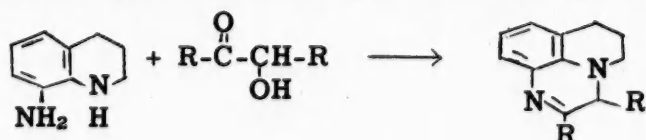
The intermediate in the condensation has been shown to be an 8-amido-THQ which, if isolated, can be cyclized to the desired product with reagents such as  $\text{P}_2\text{O}_5$ ,  $\text{POCl}_3$ , and/or  $\text{PCl}_5$ .

The spectra of the series could be used to identify the members of the series since the location of the maxima and the general shape of the curves correspond to those of the benzimidazole nucleus. The spectra indicate the effect of the 1,7-trimethylene bridge on the benzimidazole nucleus to be inductive in nature and not steric since there is little difference in the curves of benzimidazole and 5,6-dihydroimidazo[*ij*]quinoline. The observed shifts in the longer wavelength maxima have been attributed to the effect of R- on the imidazole-benzene-ring conjugative interaction. When R- was aliphatic, the effect generally was small and appeared to be inductive in nature, but when R- was aromatic, the resultant mesomeric interaction caused more significant shifts. One of the major contributors to the resonance hybrid may be as shown below. This conclusion was based upon the observation that



when R- was aromatic, the extent of the bathochromic shift (compared with the compound where  $\text{R} = \text{C}_6\text{H}_5$ -) was directly proportional to the ability of R- to accept a negative charge.

The 3,5,6,7-tetrahydro-2,3-disubstituted-pyrido[1,2,3-*de*]quinoxalines were synthesized by condensing 8-ATHQ with benzoin-type compounds. The condensations went



well in the absence of solvent and the products were highly colored and sometimes fluoresced.

Other series which were desired but for which no attempted methods of synthesis were successful were:

1. The imidazo[*ij*]quinolines by the attempted condensation of 8-amino-1,2-dihydroquinoline with certain carboxylic acids.

2. The 2-substituted-5,6-dihydrooxazoloquinolines by the attempted condensation of 8-hydroxy-1,2,3,4-tetrahydroquinoline with certain aldehydes and ketones.

3. The 2-substituted-4,5-dihydropyrrolo[*hi*]benzimidazoles by the attempted condensation of 7(?)-aminoindoline with certain carbonyl-type reagents.

Microfilm \$2.00; Xerox \$6.00. 124 pages.

### KINETICS OF THE THERMAL DECOMPOSITION OF PHENYLPHENYLSULFONYL DIIMIDE (DIAZOSULFONE)

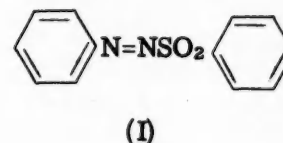
(L. C. Card No. Mic 58-2878)

Arnold J. Rosenthal, Ph.D.

Polytechnic Institute of Brooklyn, 1958

Adviser: Charles G. Overberger

The purpose of this investigation was to gain an understanding of the mechanism of the thermal decomposition of phenylphenylsulfonyl diimide (I) and substituted diimides,



and account for the decomposition products obtained.

Decomposition rate studies in benzene and alkylbenzenes were made by following nitrogen gas evolution, and by a colorimetric procedure based on the formation of phenylazo- $\beta$ -naphthol. The decomposition reaction in toluene under nitrogen proceeded autocatalytically; in all subsequent work the autocatalyzed decomposition was inhibited by calcium oxide suspended in the toluene.

The diimide decomposition rate constant in benzene increases two-fold on going from 60° to 70°, and increases four-fold from 70° to 78°.

The diimide decomposition rate constants measured at low diimide concentration in toluene, xylene, and ethyl benzene at 70° were the same as in benzene, but increased at higher concentrations; the rate constant in benzene remained constant as diimide concentration changed. The addition of typical free radical scavengers, i.e., oxygen, iodine, trinitrobenzene, chloranil, styrene, vinyl acetate and acrylonitrile, further accelerated the decomposition of phenylphenylsulfonyl diimide.

Detailed kinetic studies of the decomposition of phenylphenylsulfonyl diimide in benzene containing varying amounts of iodine, chloranil, styrene, vinyl acetate, and acrylonitrile showed an increasing decomposition rate with increasing diimide and scavenger concentrations. After extrapolation of the rate constants to zero concentration of diimide, the decomposition rates still increased with increasing scavenger concentration.

Phenylphenylsulfonyl diimide catalyzed the polymerization of styrene, methylmethacrylate, vinyl acetate, and

acrylonitrile, and under suitable conditions high molecular weight polymers were obtained. In the case of styrene a yellow polymer was obtained which contained 1.28% nitrogen and showed significant sulfone absorption in its infrared spectrum.

When the diimide was decomposed in toluene in the presence of oxygen, the course of the reaction could be followed quantitatively by the absorption of 2.2 moles of oxygen per mole of diimide decomposed.

Three alternative mechanisms can be proposed to account for the findings in the presence of the scavenger agents. All three alternatives assume that there is a spontaneous decomposition into phenylazo and phenylsulfonyl radical fragments. One possibility is that in addition there is a bimolecular reaction of the monomer or other scavenger molecules with undecomposed diimide to account for the accelerated decomposition. A second possibility is that a radical induced decomposition of kinetic order 1.0 is proceeding which operates even with very unreactive radicals and which is not eliminated by extrapolation to zero concentration of diimide. A third possibility is that the free radical fragments have a high probability of recombination and the scavenger agents compete with the recombination by capture of the free radical fragments in a cage. Our data make no clear-cut distinction among these alternatives.

To account for the findings a scheme of radical solvolysis reactions analogous to the nucleophilic substitution scheme of  $S_N1$  and  $S_N2$  reactions is proposed. The analogous radical scheme considers spontaneous cleavage and induced decomposition to be the clear cut first and second order radical reactions,  $S_{N1}$  and  $S_{N2}$ , with intermediate processes being characterized by recombination of caged fragments or some other intermediate molecular-radical structure which would exhibit reactivities such as are reported for phenylphenylsulfonyl diimide in this dissertation.

Products identified from decompositions in benzene were nitrogen gas, diphenyl, azobenzene, phenyl p-phenyl diimide, phenylsulfone, benzene sulfinic acid and diphenyldisulfide; and from decompositions in p-xylene solution, nitrogen gas, 2,5-dimethyldiphenyl, azobenzene, phenylsulfone, diphenyldisulfone, benzene sulfinic acid, phenyl p-methylbenzylsulfone, and diphenyldisulfide.

Microfilm \$2.00; Xerox \$4.60. 90 pages.

#### THE STRUCTURE AND TAUTOMERISM OF THE ESTERS OF SEVERAL SUBSTITUTED PYRUVIC ACIDS

(L. C. Card No. Mic 58-3081)

Albert Miller Stock, Ph.D.  
Lehigh University, 1958

Supervisor: E. D. Amstutz

The tautomeric behavior of methyl p-nitrophenylpyruvate, ethyl 2-benzoxazolylpyruvate, ethyl 2-quinolylpyruvate and ethyl 4-quinolylpyruvate was investigated by means of the Kurt Meyer bromine titration, the diazomethane reaction and ultraviolet and infrared absorption spectroscopy.

All of the above esters were prepared by the Claisen

condensation of methyl or ethyl oxalate with the appropriate active methyl compounds. It was known, however, that ethyl 2-pyridylpyruvate could not be prepared by this method. Several alternate methods for the synthesis of ethyl 2-pyridylpyruvate were investigated, but no satisfactory method was found.

During the attempt to synthesize ethyl 2-pyridylpyruvate, the bromination of the 2- and 4-pyridylacrylic acids was reinvestigated. This investigation led to the assignment of different structures to the previously reported bromination products. The new structures were thoroughly substantiated by experimental evidence and permitted rationalization of behavior which had been anomalous in terms of the structures suggested previously.

Evidence was presented to show that solid "methyl p-nitrophenylpyruvate," as isolated from the Claisen condensation of p-nitrotoluene and methyl oxalate, was in reality the enol, methyl  $\alpha$ -hydroxy-p-nitrocinnamate. The vinylogous relationship of this ester to p-nitrophenol was clearly demonstrated. It was also shown that the observed decrease in enol content of methanolic solutions of methyl p-nitrophenylpyruvate may not be due entirely to equilibration of the enol and keto forms of the ester, as was previously supposed.

It was demonstrated that ethyl 2-benzoxazolylpyruvate can assume a structure in which the active hydrogen is attached to the nitrogen atom of the benzoxazole nucleus rather than to the side-chain oxygen atom. Evidence for intramolecular  $O-H\cdots N$  or  $N-H\cdots O$  interaction was also obtained. It was postulated that the solid ester possessed an enol or enol-like structure which equilibrated with a tautomeric keto structure in methanol solution. The keto structure was not actually isolated, but considerable evidence for its presence in methanol solutions of the ester was obtained. The rate of the equilibration process was measured and appeared to obey first-order kinetics.

Ethyl 2-quinolylpyruvate appeared to possess a structure similar to that of "enolic" ethyl 2-benzoxazolylpyruvate. However, methanolic solutions of the 2-quinolyl ester did not decrease in "enol" content on standing, nor did the ester react with ethereal diazomethane. Thus it seemed that the "active" hydrogen atom in the 2-quinolyl ester was less acidic than those in the p-nitrophenyl and 2-benzoxazolyl esters, both of which reacted readily with diazomethane. It could not be established whether the low acidity of the hydrogen in the 2-quinolyl ester was due to very strong  $N-H\cdots O$  or  $O-H\cdots N$  interaction or to the basicity of the quinoline nitrogen atom.

Little evidence regarding the structure of ethyl 4-quinolylpyruvate was obtained, due to the instability of its methanol solutions and its failure to react with ethereal diazomethane. It was established, however, that the solid ester was highly associated. It was also shown that the observed loss of "enol" in methanol solutions of the ester was due almost entirely to some irreversible degradation process rather than to tautomeric equilibration.

Microfilm \$2.75; Xerox \$9.40. 209 pages.

# THE PREPARATION AND DECOMPOSITION OF CYCLIC AZO COMPOUNDS

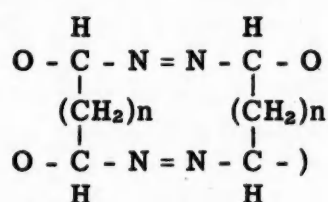
(L. C. Card No. Mic 58-2885)

Irving Tashlick, Ph.D.  
Polytechnic Institute of Brooklyn, 1958

Adviser: Charles G. Overberger

The investigation of cyclic azo compounds was undertaken in order to study the properties of the moderately active diradicals which could result from the thermal decomposition of these compounds. It was desired to obtain information on the properties of these diradicals in solution, the effect of ring size on the decomposition rate, whether a diradical could be scavenged and whether the decomposition was stereospecific in nature.

To carry out this study, 20-, 24- and 28-membered ring compounds (A) and the 8-membered ring 3,8-diphenyl-



(A)  $n = 6, 8, 10$

1,2-diaza-1-cyclooctene were synthesized. The large ring compounds were decomposed at 110°, 120° and 130° in xylene. The activation energies for decomposition were found to be 34.8, 34.4 and 33.7 kcal/mole respectively, which were slightly higher than that of the linear analog 1-azo-bis-1,1-phenylpropane (32.3 kcal/mole). The infrared and ultraviolet spectra of the large ring azines and azo compounds were found to be very similar to those of the linear analog.

The 20- and 28-membered ring azo compounds yielded cyclic hydrocarbons on decomposition in xylene in 66% and 84% yields in a similar manner to the 24-membered ring.

The 24-membered ring azo compound was decomposed in the presence of several radical scavengers. An uncharacterizable adduct was obtained with maleic anhydride and trace quantities of an adduct with *cis*-stilbene. It was found that 16% of the radicals from 1-azo-bis-1,1-phenylpropane were scavenged by *cis*-stilbene, showing that a large cage effect was operating in the case of the cyclic compound. An attempt was made to initiate the copolymerization of styrene and maleic anhydride with the cyclic azo compound.

3,8-Diphenyl-1,2-diaza-1-cyclooctene was decomposed in tetralin at four temperatures, and was found to be unexpectedly stable. The activation energy for decomposition was 36.7 kcal/mole, and the calculated rate of decomposition at 80°C was 1/180 of that of 1-azo-bis-1-phenylpropane, several suggestions for this stability are offered. It was found to yield 50% of 1,6-diphenyl-1-hexene when decomposed in tetralin at 165-170°C and a 43% yield of a mixture of *cis*- and *trans*-1,2-diphenylcyclohexanes. This latter result was taken as evidence that the intermediate diradical was free enough to lose its stereoidentity before coupled products were formed.

Microfilm \$2.00; Xerox \$4.80. 92 pages.

# CHEMISTRY, PHARMACEUTICAL

## ANTISPASMODICS: SUBSTITUTED beta-PHENYL-gamma-HYDROXYPROPYLAMINES AND THIAZOLE ANALOGS OF MEPERIDINE

(L. C. Card No. Mic 58-3650)

Gordon Spencer Dean, Ph.D.  
University of Michigan, 1958

Among the compounds which have been found to exhibit antispasmodic activity are beta-diethylaminoethyl alpha-phenyl-alpha-(1-hydroxycyclohexyl)acetate and meperidine. Since the former substance, as well as a large number of structurally related antispasmodics, are prepared by the use of an Ivanov reagent, a general study of this type of reagent is of interest.

A typical Ivanov reagent is the alpha-chloromagnesium derivative of the chloromagnesium salt of phenylacetic acid  $\text{C}_6\text{H}_5\text{CH}(\text{MgCl})\text{-COOMgCl}$ , which is prepared by the interaction of phenylacetic acid and isopropylmagnesium chloride. During this investigation, it was found that an Ivanov-type reagent can be obtained by the addition of N, N-dimethylphenylacetamide to isopropylmagnesium chloride. This reagent,  $\text{C}_6\text{H}_5\text{CH}(\text{MgCl})\text{CON}(\text{CH}_3)_2$ , reacts in the same general manner as an Ivanov reagent, and with carbonyl compounds beta-hydroxy amides are produced.

The alpha-chloromagnesium derivatives of N,N-dimethyl-, N,N-diethyl-, N,N-dipropyl- and N,N-diisopropylphenylacetamide and phenylacetmorpholide were allowed to react with each of the following aldehydes and ketones: formaldehyde, benzaldehyde, acetophenone, benzophenone, cyclopentanone and cyclohexanone. In this manner, thirty substituted alpha-phenyl-beta-hydroxypropionamides were obtained. Sixteen of the amides were reduced with lithium aluminum hydride to substituted beta-phenyl-gamma-hydroxypropylamines. These amines may prove to be of value because of their structural similarity to certain commercial antispasmodics.

Since a study of the effect of the replacement of an aromatic nucleus in a pharmacologically active compound by a thiazole ring is of interest, five thiazole analogs of meperidine (Demerol) were synthesized. These compounds are:

Ethyl 1-methyl-4-(2-methyl-4-thiazolyl)piperidine-4-carboxylate

Ethyl 1-methyl-4-(2-ethyl-4-thiazolyl)piperidine-4-carboxylate

Ethyl 1-methyl-4-(2, 4-dimethyl-5-thiazolyl)piperidine-4-carboxylate

Ethyl 1-methyl-4-(2-ethyl-4-methyl-5-thiazolyl)piperidine-4-carboxylate

Ethyl 1-benzyl-4-(2, 4-dimethyl-5-thiazolyl)piperidine-4-carboxylate

The 4-thiazole analogs were obtained from ethyl 2-methyl-4-thiazoleacetate or ethyl 2-ethyl-4-thiazoleacetate by a series of reactions which involved the successive conversion of the ester into the amide, nitrile, condensation of the nitrile with methyldi(beta-chloroethyl)amine to form 1-methyl-4-[2-methyl-(or 2-ethyl)-4-thiazolyl]-4-cyanopiperidine, and then the transformation of the cyano group into carboxyl and carbethoxy. The esters were isolated as the hydrochlorides.

The 5-thiazole analogs were prepared from ethyl 2,

4-dimethyl-5-thiazoleacetate or ethyl 2-ethyl-4-methyl-5-thiazoleacetate in the general manner described above.

The thiazole analog which contained a 1-benzyl group was synthesized by the use of benzyldi(beta-chloroethyl)amine. Microfilm \$2.00; Xerox \$4.80. 92 pages.

#### DECOMPOSITION OF ASPIRIN IN THE SOLID STATE

(L. C. Card No. Mic 58-3697)

Lewis Joseph Leeson, Ph.D.  
University of Michigan, 1958

In spite of the popularity of solid medicinal forms such as tablets, capsules, etc., a reliable method for predicting stability of drugs in the solid state has never been developed. Kinetic studies have been used successfully to predict stability for solutions of drugs, and it was felt that they might also be applicable to solid forms.

A study was undertaken to determine the mechanism and kinetics of the decomposition of aspirin in the solid state. This drug was selected because it is widely used and is known to decompose in solid form.

Initially, crystalline aspirin was stored at various temperatures and humidities, and samples were periodically removed for analysis to determine the extent of decomposition. The results indicated that breakdown is dependent on both temperature and humidity, and from these results a reaction mechanism was proposed. This mechanism consists of an initial adsorption of water by aspirin, diffusion into solution, and decomposition taking place by acid-catalyzed hydrolysis. The data obtained were demonstrated to fit the following equation describing the breakdown of aspirin into salicylic and acetic acids:

$$\log \frac{A_0(10 + C^{1/2})^2}{A(10 + C_0^{1/2})^2} = \frac{10}{2.303} (k_t K^{1/2} P^{3/2})t,$$

where A is the mole percent aspirin, C the mole percent salicylic acid,  $A_0$  and  $C_0$  are the respective values of A and C at time zero,  $k_t$  is the specific rate constant, K the ionization constant of acetic acid, p the aqueous vapor pressure and t the time.

Decomposition of tablets prepared from the aspirin crystals used in the initial study followed the above equation. Tablets prepared from a commercial granulation were found to become independent of vapor pressure at higher values. The equation was still applicable, however, since the adsorption of water was found to behave as though it followed the Langmuir isotherm. From the data obtained it was possible to predict the stability of aspirin in the solid state at any temperature and humidity.

It is suggested that the basic assumptions and treatment of data used in this study show promise of being applicable to many solid medicinals which decompose by hydrolysis.

Microfilm \$2.00; Xerox \$5.40. 109 pages.

#### FORMULATIONS FOR COMPRESSION COATED TABLETS

(L. C. Card No. Mic 58-3703)

Werner Lowenthal, Ph.D.  
University of Michigan, 1958

Compression coating will soon be widely used in the pharmaceutical industry. Mechanical and engineering developments have progressed so that machines suitable for routine production are available. The adoption of this method of coating poses many new formulation problems as well as a need for basic studies of factors important to the process.

The immediate objective of this project was to determine which factors are important and how they might be controlled. Compression coating was performed on two different machines, the Kilian "Prescoter" and the Colton No. 232 Compression Coater. All the experiments used 5/16 in. cores to make 7/16 in. finished tablets.

It was found that weight variation of compressed coatings was generally quite low, the range being 1.31% to 1.70%. Disintegration of coatings varied with materials but could be controlled by proper choice of lubricant and starch concentration. For example, terra alba coatings made at high pressure and with 5% starch had an average disintegration time of 1160 sec.; by adjustment of pressure and lubricant and use of 10% starch this time was reduced to 66 sec.

Void fraction was considered important in producing a strong coating and was measured by both vibrator and tapping methods. It was not altered by the variables of the process such as sizes of screens used for granulating, binders and their concentration, particle size distribution and internal lubricants; thus its effect could not be evaluated.

Median particle size of coating granules obtained with Fitzmill was 183 microns, this being smaller than the size, 284 microns, obtained with the oscillating granulator. Disintegration and weight variation could be related to the median particle size, smaller particles size giving faster disintegration and larger weight variation.

Coating strength was considered to be the most critical characteristic of compression coated tablets because coatings which will withstand shock and abrasion are difficult to obtain. Plasticizers, such as sucrose and Sorbo<sup>R</sup>, added to binder solutions were shown to increase coating strength without affecting the bonding between coating and core.

Physical changes in the core were also investigated. Since the coating is weak along the edge, it was thought that expansion of core diameter during coating would increase compression of coating granulation and produce a stronger coating. Attempts to modify core properties with plasticizers, fibrous materials or softening agents were generally unsuccessful but did show that core diameter distortion could be related to coating strength. Higher pressure was found to increase core distortion and improve coating strength.

Multivariate analysis was used to evaluate the relationship of coating strength with core thickness, core density, coating thickness and coating density as independent variables and core diameter expansion, hardness on face and edge of coating, core thickness decrease, and tablet expansion as dependent variables. It was found that coating strength ( $Y_1$ ) could be predicted from core density ( $x_2$ )

and coating density ( $X_4$ ). Examples of the equations relating these properties are:

$$Y_1 = -0.7181 X_2 + 2.6385 X_4 - 1.5713 \text{ (terra alba coating and cores)}$$

$$Y_1 = -1.6090 X_2 + 2.1571 X_4 + 3.0461 \text{ (lactose coating and sodium bicarbonate cores)}$$

The correlations of dependent variables confirmed the belief that coating strength measurements were directly related to strength of the coating on the tablet edges. Further, deformation of the core during coating was shown to occur as coating strength was increased.

Microfilm \$2.50; Xerox \$8.60. 189 pages.

## CHEMISTRY, PHYSICAL

### EFFECT OF VISCOSITY ON RADICAL FORMATION AND RECOMBINATION

(L. C. Card No. Mic 58-2862)

Ibrahim A. Aboul-Saad, Ph.D.

Polytechnic Institute of Brooklyn, 1958

Adviser: Frederick R. Eirich

Co-Adviser: H. F. Mark

This dissertation deals with the effect of solvent viscosity on the rate of formation of free radicals by thermal decomposition and on the rate of their recombination.

During work started on the determination of chain transfer constants during the polymerization of styrene in solutions containing lactams, curvatures in the plot of reciprocal degree of polymerization vs. the solvent monomer ratios were observed which indicated the influence of solvent viscosity.

To our knowledge, such an influence has not been reported in any detail in systems of low viscosity polymerized to low conversions. While it is likely that our observations were connected with the delay in termination of polymerization normally termed "Trommsdorff effect" and with the so-called efficiency of thermally decomposing radical sources, our finding raised interesting speculations as regards the influence of the structural mobility of the solvent on free radical reactions.

In order to obtain data suitable for interpretation, a series of polymerization experiments of styrene were carried out with ABIN and BPO as initiators, whereby the viscosity was kept constant while varying solvent composition and, vice versa, solvent composition was kept as constant as possible while varying the viscosity. Applying the well established scheme of polymerization kinetics to this case, a straight forward derivation leads to functions of  $k_p \left( \frac{fk_d}{k_t} \right)^{1/2}$  and of  $k_p / (fk_d k_t)^{1/2}$  where

$k_p$  is the propagation rate constant

$k_t$  is the termination rate constant

$k_d$  is the decomposition rate constant of the initiator and  $f$  is the initiator efficiency.

These expressions should be independent of composition or dilution. This was found not to be the case. A clear dependence was established when these two "constants" were plotted against viscosity. The first plot represents the effect of viscosity on the rate of polymerization and the second that on the degree of polymerization.

In addition, we find that for BPO there is no change in efficiency with variation of solvent but a change of decomposition rate constant as a function of viscosity. For ABIN we find primarily changes in efficiency, whereas the changes in rate constant are minor. Making reasonable assumptions about the size of the radicals and introducing the macroscopic viscosity into Rabinowitch's equation, we could calculate the recombination rate constants of primary radicals independent of environment. Further, deriving the duration of an encounter according to Rabinowitch, we could calculate the probability of radical reactions during a set of collisions and according to Noyes the probability of encounter once radicals have escaped from the cage.

We were able to show also that the recombination of BPO radicals occurs apparently more slowly than that of ABIN decomposition products. An analysis of the rate constants and considerations of the effect of the decomposition products on the liquid cage led to the conclusion that the splitting out of nitrogen probably does not occur by two concerted bond breakages but rather by consecutive steps.

Similarly as for the decomposition step, we could calculate from our data the recombination rate constant independent of environment and the probability of recombination after an encounter for the termination step. In an indirect way our results point also to the fact that the "true" activation energy is considerably lower than the experimentally determined value, since the latter includes the activation energy of diffusion which has a large effect on the process of termination.

Finally, a detailed discussion of Rabinowitch's and Noyes's theories shows that they are compatible with the results reported herein.

Microfilm \$2.00; Xerox \$5.20. 104 pages.

### PHOTOCONDUCTIVE PROPERTIES OF SOME PHTHALOCYANINE COMPLEXES

(L. C. Card No. Mic 58-2900)

John Arthur Bornmann, Jr., Ph.D.

Indiana University, 1958

It has been found that in the presence of oxygen the photoconductive behavior of the metal complexed phthalocyanines differs from that of metal-free phthalocyanine. Oxygen increased the photoconductivity of cobalt, copper and lead phthalocyanines and changed the time response of the photocurrent of these compounds. The increase of photocurrent with time in the case of metal free phthalocyanine and of the metal complexed phthalocyanines in a vacuum could be described by the equation:

$$i_p = i_{\max}(1 - e^{-at})$$

where  $i_p$  is the photocurrent,  $t$  is the time,  $a$  is a constant and  $i_{\max}$  is the maximum photocurrent obtained at steady state conditions.

In the presence of oxygen the photocurrents of metal complexed phthalocyanines did not reach a maximum and a steady state. The rise of their photocurrents could be described by the equation:

$$i_p = i_{\max}(1 - e^{-at}) + Bt$$

where B was a constant. When the illumination ceased, the currents did not return to the original dark currents but to a higher value.

The increase of photoconductance with oxygen pressure in the case of lead and copper phthalocyanines followed a Langmuir adsorption isotherm. A plot of oxygen pressure divided by photoconductance versus oxygen pressure gave a straight line.

The spectral response of copper and lead phthalocyanines in the presence of oxygen was obtained. The long wavelength threshold of spectral response corresponded to the threshold of optical absorption. Two maxima corresponding in both the optical absorption and spectral response of copper phthalocyanine were found.

The photocurrents of cobalt, copper and lead phthalocyanines were proportional to a power of the light intensity which lay between 1/2 and 1.

The dark currents of the metal complexed phthalocyanines were also affected by oxygen. The dark conductivity was linearly dependent on the oxygen pressure.

The photocurrents of all the metal complexed phthalocyanines obeyed Ohm's law. The dark currents of cobalt and copper phthalocyanines also obeyed the law but the dark currents of lead phthalocyanine increased with voltage in more than a linear fashion.

Microfilm \$2.00; Xerox \$5.00. 100 pages.

#### ADSORPTION OF ALKYL HALIDE GASES ON SODIUM CHLORIDE

(L. C. Card No. Mic 58-2995)

Frank Clark Edwards, Ph.D.  
Iowa State College, 1958

Supervisor: R. S. Hansen

The Edwards-Baldwin magnetically compensated fused-silica fiber microbalance was adapted for gas adsorption studies. This involved modifications of balance design which resulted in improved operating characteristics. Based on this balance a gas adsorption apparatus was devised with the following properties:

1. Weight measurements can be made in absolutely controlled atmospheres without disturbing the system.
2. Weight sensitivity is 0.1 microgram with 2 grams load.
3. Pressure measurement is by a second magnetically compensated microbalance on the gas density principle, with sensitivity to 0.03 mm. of Hg for representative gases.
4. The whole assembly can be conveniently immersed in a water bath of moderate size.
5. All valves are of the Bayard-Alpert type, permitting bakeout of the entire apparatus.

The apparatus proved practical for gas adsorption

measurements with low area adsorbents - sufficiently low to be well characterized in crystal habit.

Isotherms for the adsorption of ethyl chloride, ethyl bromide, ethyl iodide, and methyl iodide on cubic habit sodium chloride were determined over the entire pressure range and at several temperatures in each case. The character of these isotherms was such that they could not be represented by any theory of adsorption available in the literature. These isotherms were found to be reasonably well represented by a new treatment of gas adsorption developed in this laboratory. The parameters necessary for these representations were determined (including temperature dependence) and found to be physically reasonable.

It was concluded that the adsorption of alkyl halides by sodium chloride can be well characterized by a regular localized monolayer for the first adsorption layer, with a liquid film building on top of that fraction of the first layer sufficiently densely populated to accommodate it.

Microfilm \$2.00; Xerox \$5.40. 110 pages.

#### SOME PHYSICO-CHEMICAL ASPECTS OF RUTHENIUM TETROXIDE

(L. C. Card No. Mic 58-3039)

Richard E. Ewing, Ph.D.  
State College of Washington, 1958

The adsorption of ruthenium tetroxide vapor by activated alumina and the adsorption of ruthenium tetroxide from carbon tetrachloride solutions by activated alumina were investigated. The isotherms for the vapor at two different temperatures were determined and were used for calculating the entropy, free energy, and heat of adsorption. The values for these thermodynamic constants together with the desorption isotherm indicate the adsorption process to be predominately physical especially at the higher pressures with some chemical decomposition of the adsorbed molecules. The magnitude of the error due to the decomposition of ruthenium tetroxide was not determined. The nonconformity of the data with any of the adsorption theories at low pressures was attributed to the errors introduced by the decomposition of the adsorbed molecules. At the high pressures, the error was presumed to be small compared to the amount adsorbed on the basis of the almost complete conformity of the data to the Harkins-Jura isotherm which was applicable almost to the saturation point. The cross-sectional area of the ruthenium tetroxide was calculated to be 34.6 square Angstroms. The calculation was based on the assumption that only the monolayer formed on the alumina from carbon tetrachloride solutions of ruthenium tetroxide.

Microfilm \$2.00; Xerox \$3.00. 44 pages.

# THE MATRIX ABSORPTION PROBLEM IN X-RAY FLUORESCENCE SPECTROSCOPY

(L. C. Card No. Mic 58-2865)

Edward J. Felten, Ph.D.  
Polytechnic Institute of Brooklyn, 1958

Advisers: Joseph Steigman and Isidor Fankuchen

Matrix absorption and secondary emission effects, which complicate the relationship between the intensity of the X-ray fluorescence and the concentration of the fluorescing atom, have been the subject of numerous investigations in the field of X-ray spectroscopy. Experimental techniques have been developed and mathematical expressions derived which tend to lessen or compensate for these effects.

It has been postulated that as the thickness of a specimen decreases, absorption effects become smaller. Here a thin specimen is achieved by impregnating filter paper (Whatman #1) in 0.1 and 0.2 molar binary solutions of iron with other transition metals. While the absolute amounts of the elements absorbed are not constant, the relative amounts do remain constant. The fluorescent intensity due to each metal ion in a single thickness of specimen paper is only a small fraction of the intensity produced by a bulk specimen of the metal ( $> 0.004$  cm. thick). Here measurements on from one to six thicknesses of paper were made. As the thickness of a specimen becomes smaller, the intensities due to the fluorescing species decrease in a regular manner, becoming zero at zero thickness. The ratio of the intensities of the two fluorescing elements approach a limiting and finite value. The relationship between the intensity ratio and thickness can be described by the expression

$$\log R = a + bT$$

where  $a$  is  $\log R_0$ ,  $T$  is the number of thicknesses of specimen measured, and  $b$  is the slope of the curve.

The intensity ratio at zero thickness is called the limiting intensity ratio,  $R_0$ , and is determined using a least squares procedure. It is shown that in the binary systems investigated,  $R_0$  is related simply to the molar concentrations of the metals present. The  $R_0$  values have been used to give an accurate estimate of the concentration by weight of the metals present, assuming that no foreign ions were present. Similar calculations using ratios obtained at finite thicknesses show an increase in error as the specimen thickness increases.

A modified form of the filter paper technique was used to determine metal ion concentrations in dilute solutions. An internal standard is used for these measurements.

Two methods were investigated to obtain absolute concentrations of the metals present in a binary mixture, namely, an internal standard method and a dilution method. The internal standard method involves the addition of a known amount of a third element to a binary mixture. Here nickel was added to a series of iron-copper solutions. Limiting ratios of the intensities of nickel to iron and nickel to copper were used to determine the iron and copper concentrations. The ratios at a specimen thickness of one paper give somewhat poorer, although satisfactory results for considerably less effort, requiring a shorter counting time and eliminating extrapolation of the ratios.

The dilution method is based on the difference in  $R_0$

obtained from specimens impregnated before and after the addition of a known amount of one of the elements already present in a binary mixture. The method was tested on a series of iron-transition metal solutions. A variation of this method is used in radiochemistry separations.

Of the two procedures, the internal standard method is the superior. Most results obtained were within five percent of the amount of iron or copper present in a series of mixtures in which their concentrations varied widely. The dilution method is too sensitive to ratio differences and is not capable of giving even reasonably accurate results.

Microfilm \$2.15; Xerox \$7.60. 164 pages.

# THE OXIDATION OF DIMETHYLANILINE AND RELATED COMPOUNDS

(L. C. Card No. Mic 58-2868)

Donald McLean Graham, Ph.D.  
Polytechnic Institute of Brooklyn, 1958

Adviser: Robert B. Mesrobian

The oxidation of dimethylaniline by oxygen and by benzoyl peroxide has been investigated.

The autoxidation reaction appeared to be autocatalytic and autoinhibited. It proved impossible to obtain reproducible reaction rates in this case, but the reaction was shown to be catalyzed by ferric compounds, and inhibited by quinone, hydroquinone, and methylaniline.

Oxidation by benzoyl peroxide led to the formation of a derivative of tetramethylbenzidine, and a reaction mechanism based on this compound and its semiquinone as chain carriers, was used to explain the observed kinetics.

When benzoyl peroxide was used to initiate the reaction of oxygen with dimethylaniline, a similar chain reaction occurred resulting in an almost quantitative production of hydrogen peroxide. The reaction was inhibited by mercaptan and quinone, but not by hydroquinone; and was shown to be autoinhibited as well. The rate was observed to be much greater in polar solvents (acetonitrile and methanol) than in toluene or benzene. Diethyl- and dipropylaniline exhibited no chain characteristics under similar conditions, but Michler's Hydride oxidized at a much greater rate than did dimethylaniline and also exhibited chain characteristics.

An electron transfer mechanism has been postulated, involving both semiquinone and peroxidic chain carriers, which is consistent with all of these observations. From an analysis of the oxidation rates in the presence and the absence of mercaptan inhibition, the appropriate rate constants have been determined.

Microfilm \$2.00; Xerox \$5.60. 114 pages.

# CHARACTERISTIC INFRARED ABSORPTION FREQUENCIES OF NITROGEN-CONTAINING BONDS

(L. C. Card No. Mic 58-2997)

Linsley Shepard Gray, Jr., Ph.D.  
Iowa State College, 1958

Supervisor: V. A. Fassel

A series of nitrogen-containing organic compounds labeled with nitrogen-15 was prepared, starting with enriched ammonium sulfate. The spectra of the labeled compounds and the analogous unlabeled compounds were compared in the region 4000-420  $\text{cm}^{-1}$ . Bands which showed an isotopic shift were used to indicate the possible nature of the modes of vibration associated with the various nitrogen-containing functional groups. Several significant observations were made. Tentative assignments were made for the species studied.

In benzamide it is shown that the vibration giving rise to the Amide I band involves considerable nitrogen motion while the Amide II band is affected by the isotopic substitution no more than would be expected for an N-H vibration. On the other hand, in acetanilide, benzanilide, and n-hexanilide the results obtained for the Amide I band indicate little involvement of the nitrogen atom in the vibration while the Amide II band is considerably affected by the isotopic substitution. The data indicate a fundamental difference in the character of the modes of vibration in unsubstituted amides and monosubstituted amides. In none of the above compounds is there any band which can be assigned to a purely C-N vibration.

In the spectrum of aniline hydrochloride there is no band in a reasonable region which shifts enough to be assigned to a C-N stretching vibration. The largest shift observed above 600  $\text{cm}^{-1}$  is only about one-third the displacement expected for a C-N vibration. The C-N in-plane bending mode is observed.

From the results obtained for n-hexyl nitrite it is concluded that the N=O bond exhibits a relatively pure stretching vibration and that the C-O-N portion of the nitrite group behaves as an interacting system. Vibrations which are essentially asymmetric and symmetric stretching modes of the C-O-N system are discussed, as well as a C-O-N deformation vibration and a N=O bending mode.

Benzenediazonium chloride shows essentially pure nitrogen-nitrogen and carbon-nitrogen stretching vibrations. The results confirm previous assignments of the nitrogen-nitrogen stretching mode. The in-plane bending vibration of the diazonium group is located.

The spectrum of p-N,N-dimethylaminoazobenzene reveals three bands assignable to vibrations of the azo group. None of the absorptions can arise from a simple nitrogen-nitrogen stretching mode. It is concluded that these bands should appear in all trans aromatic azo compounds and that three additional bands, whose positions are at present unknown, should be found in compounds with less symmetry in the region of the azo bond.

Microfilm \$2.00; Xerox \$5.20. 105 pages.

# REACTIONS OF 1,10-PHENANTHROLINE WITH HYDROGEN, LITHIUM, SODIUM AND POTASSIUM IONS

(L. C. Card No. Mic 58-2998)

Patrick Gerard Grimes, Ph.D.  
Iowa State College, 1958

Supervisor: Charles V. Banks

Spectrophotometric equilibrium studies, and titrimetric pH measurements were found to be unsuitable for measuring the weak complexes of 1,10-phenanthroline (A) with alkali metals. The existence of poly-1,10-phenanthroline hydrogen ion species, indicated by pH measurements, was demonstrated by studies on the solubility of (A) in hydrochloric acid solutions. The aqueous molar solubility of (A) was 0.016 M. The slope of the linear plot of molar solubility vs. acid concentration was 2.48 at 25°C; and 2.64 at 40°C. demonstrating species containing ratios of (A) to hydrogen ion of 1:1, 2:1, and 3:1. These species were also indicated in conductometric titration of solutions of (A) in hydrochloric acid with hydrochloric acid. Similar titrations using 80% ethanol as solvent indicated the existence of species having higher ratios of (A) to hydrogen ion.

A method of measuring free-base (A) with a silver/bis-(1,10-phenanthroline)silver(I) nitrate (S/BPSN) electrode was developed. The stability constants  $\text{pK}_2=11.6$  for bis-(1,10-phenanthroline)silver(I) (B) and  $\text{pK}_1$  = approximately 4 for mono(1,10-phenanthroline)silver(I) (C) were estimated from the potentiometric titrations of silver nitrate and silver sulfate with (A). The  $K_{\text{sp}}$  of the nitrate salt of (B) was found to be  $10^{-8.8}$ . The (S/BPSN) electrode was prepared by electrolyzing a silver electrode in a solution 0.001 N in potassium nitrate and 0.010 N in (A). The working standard reduction potential of -0.311 volt vs. hydrogen was determined for the (S/BPSN) electrode from measurements of solutions having known concentrations of nitrate ion and free-base (A) with the (S/BPSN) -0.1 N potassium nitrate in agar-agar-saturated calomel electrode system.

This electrode system was used to follow the titration of 0.01 N metal nitrate solutions approximately 0.18 M in (A) with 0.01 N metal nitrate solutions. The metal nitrate solutions were buffered; zinc nitrate at pH 4.7 with acetic acid-sodium acetate, and alkali metal nitrates at pH 9.2 with alkali metal hydroxide-boric acid. The titration of 0.07 N nitric acid solution 0.134 M in (A) with 0.07 N nitric acid was followed in a similar manner. The concentration of nitrate ion and the ionic strength was maintained at a constant value with this type of titration.

Free-base (A), computed from the potential of the electrode system, was used to estimate the  $\text{pK}$  values. The stepwise  $\text{pK}_i$  values obtained for complexes of (A) were as follows: Zn,  $\text{pK}_1=6.58$ ;  $\text{pK}_2=5.8$ ;  $\text{pK}_3=4.8$ ; Li,  $\text{pK}_1=1.78$ ;  $\text{pK}_2=4.4$ ; Na,  $\text{pK}_1=1.58$ ;  $\text{pK}_2=4.25$ ; K,  $\text{pK}_1=1.0$ ;  $\text{pK}_2=4.04$ ; H,  $\text{pK}_1=5.05$ ;  $\text{pK}_2=8.3$ ;  $\text{pK}_3=10.3$ . Bis(1,10-phenanthroline)-lithium(I) and bis(1,10-phenanthroline)sodium(I) perchlorates were prepared by precipitation from solutions 0.01 M in (A), 0.5 M in alkali metal hydroxide, and 0.1 M alkali metal perchlorate.

Microfilm \$2.00; Xerox \$4.60. 92 pages.

**EQUILIBRIA STUDIES  
IN NON-AQUEOUS SOLVENTS**

(L. C. Card No. Mic 58-2968)

Ray Eicken Humphrey, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Alexander I. Popov

**PART I****INFRARED STUDY OF HALOGEN COMPLEXES**

The effect of the formation of charge transfer complexes on the fundamental infrared absorption band of iodine monochloride at  $375\text{ cm}^{-1}$  was studied employing many different types of complexing substances. The compounds investigated can be classified into four groups, based on the position of the iodine monochloride fundamental vibration band in the presence of each complexing substance. Group I consists of those solvents causing no change in the position of the  $375\text{ cm}^{-1}$  band and includes carbon tetrachloride, cyclohexane, n-heptane, and n-hexane. The solvents comprising Group II, carbon disulfide, ethylene chloride, nitrobenzene, and nitromethane, caused the band to shift to  $363\text{ cm}^{-1}$  and resulted in some increase in band intensity. The iodine monochloride fundamental appeared at  $355\text{ cm}^{-1}$  and was further intensified in the presence of the substances of Group III, consisting of acetonitrile, benzene, dioxane, toluene, and p-xylene. The substances comprising Group IV, 2,2' bipyridine, pyridine, and pentamethylenetetrazole, form solid complexes with iodine monochloride which can be isolated from solution. The fundamental band for this interhalogen is shifted to  $308\text{ cm}^{-1}$  with 2,2' bipyridine and pentamethylenetetrazole, and to  $280\text{ cm}^{-1}$  with pyridine. The intensity is again increased considerably. In general, it was found that the iodine monochloride fundamental was shifted to lower frequency and increased in intensity and half-intensity band width with complex formation, the magnitude of these changes being greater with increasing interaction between the interhalogen and the complexing substance.

Difficulties were encountered because of reaction of iodine monochloride with the substituted aromatic compounds and with the cesium bromide windows of the infrared cell, the latter reaction occurring when the interhalogen was dissolved in solvents of higher dielectric constants. In order to avoid these reactions, mixed solvents were used, which usually consisted of small amounts of the reactive substance in carbon tetrachloride.

The effect of complex formation on the three fundamental infrared bands of iodine cyanide, the C - N stretch at  $2168\text{ cm}^{-1}$ , the I - C stretch at  $486\text{ cm}^{-1}$ , and the C - N bend at  $320\text{ cm}^{-1}$ , was studied employing a wide variety of compounds. The effect of complex formation on the I - C stretching vibration was similar to that observed with the I - Cl band, with greater decreases in frequency and increases in intensity and half-intensity band width with the formation of more stable complexes. No significant changes were found in the C - N stretching band except in the presence of pyridine, where the band intensity was very low. The C - N bending vibration was shifted to  $330\text{--}336\text{ cm}^{-1}$  with certain complexing agents, but this change did not seem to be related in any apparent manner to the strength of interaction.

Formation constants were calculated for the reaction of iodine cyanide with dioxane, pentamethylenetetrazole, and pyridine and for the reaction of iodine monochloride with benzene. The values for the dioxane-iodine cyanide and benzene-iodine monochloride formation constants were determined by use of the Scott modification of the Benesi-Hildebrand equation. These calculations were possible because of the presence of two absorption peaks when small amounts of complexing agent were used, one being due to the complexed interhalogen, and the other appearing at the position of the band for the uncomplexed material.

**PART II****ABSORPTION SPECTRA AND DISSOCIATION  
OF ION-PAIRS IN VARIOUS SOLVENTS**

The electrical conductance of tetraphenylarsonium chloride was determined in water, acetonitrile, 70 per cent dioxane, ethylene chloride, and 95 per cent dioxane. In water and acetonitrile the compound behaved as a strong electrolyte, with the experimental slope of the Kohlrausch plot having a value differing very little from the theoretical Onsager slope. In the dioxane-water mixtures and ethylene chloride, ion association was observed. Ion-pair dissociation constants were calculated for this compound in 70 per cent dioxane and ethylene chloride by the Fuoss-Kraus extrapolation procedure and in 95 per cent dioxane by use of the Ostwald dilution law, after assuming a value for the limiting equivalent conductance by application of Walden's rule. Over 99 per cent association was found in the latter solvent.

The ultraviolet absorption spectrum of tetraphenylarsonium chloride was determined in each of the solvents in which the conductance was studied. The compound has three ultraviolet peaks which occur at 258 m $\mu$ , 264 m $\mu$ , and 271 m $\mu$ , with molar absorptivities of 2550, 3340, and 2780 respectively, in water solution. It was found that there was no observable change in the position of the absorption peaks in going from solvent to solvent. Small changes were observed in the molar absorptivity values for the three peaks in the different solvents but it was not possible to correlate these changes with the amount of ion-pair formation. It would appear that ion-pair formation has no detectable effect on the ultraviolet absorption spectrum of tetraphenylarsonium chloride.

The conductance of sodium tetraphenylborate, tetraphenylarsonium tetraphenylborate, and tetraphenylarsonium picrate were also determined in acetonitrile. It was found that all of these compounds were essentially completely dissociated in this solvent. The value for the limiting equivalent conductance of tetraphenylarsonium tetraphenylborate agreed closely with the value calculated from the sum of the ionic conductances. The absorption spectra of these compounds were also determined.

The conductance and ion-pair dissociation constant were also determined for tetraphenylarsonium picrate in ethylene chloride. The absorption spectrum of this compound in ethylene chloride did not obey Beer's law, as the molar absorptivity values increased with increasing dilution.

Microfilm \$2.20; Xerox \$7.80. 168 pages.

SOME NEAR ULTRAVIOLET ABSORPTION  
STUDIES IN CONDENSED PHASE:  
I. SOME NEAR ULTRAVIOLET ABSORPTION  
SPECTRA OF BENZENE AND SOME  
BENZOTRIFLUORIDES.  
II. NEAR ULTRAVIOLET ABSORPTION  
SPECTRA OF THE SYSTEM: QUINOLINE-  
TRICHLOROACETIC ACID-ISOOCTANE.

(L. C. Card No. Mic 58-2735)

Anna Pitts Johnson, Ph.D.  
Duke University, 1958

Supervisor: Marcus E. Hobbs

Part I

The absorption spectra of benzene, the three chlorobenzotrifluorides, 1,4-bis-(trifluoromethyl)benzene, and 1,3,5-tris-(trifluoromethyl)benzene were examined in isooctane and in 95% ethyl alcohol solution in the 2000-4000 Å region. The spectra of the pure compounds were measured in the region of 2700-4000 Å.

A calibrated Beckman Model DU spectrophotometer, equipped with a 1P28 photomultiplier tube and provided with a cell housing maintained at  $30.0 \pm 0.1^\circ\text{C}$ , was used. Such slit widths and sensitivity were utilized that the total spectral band width was 2 to 3 Å throughout the region investigated. Optical paths of 1, 5, 10, and 100mm were employed in studying the solutions ( $3.6 \times 10^{-5}$  to 3.5M). The pure liquid compounds, in 10 and 100mm cells, were compared optically with isooctane. Isooctane was purified by selective adsorption on silica gel. The other compounds were purified by careful fractional distillation.

Three electronic transitions were studied. The isomeric chlorobenzotrifluorides showed the influence of both substituent groups on the spectra of the parent compound, benzene. This was interpreted in terms of the interaction across the ring of the substituents when they are in the three possible positions. Spectra of the 1,4-bis- and 1,3,5-tris-(trifluoromethyl)benzenes were interpreted in terms of the inductive effect of the substituent group on the benzene ring. A correlation was made between the resultant spectroscopic moments of the compounds and the frequency and intensity of absorption in the 2000 and 2600 Å electronic transitions of benzene.

In the long wavelength region a low absorption electronic transition was observed. The 3400 Å transition in benzene is comprised of six bands separated by a spacing of  $920\text{ cm}^{-1}$ . In the substituted benzenes, there is a modification by the substituents present of both the characteristic appearance and position of the benzene absorption.

Part II

Absorption spectra of the quinoline-trichloroacetic acid-isooctane system were studied in the wavelength region of 2000-3500 Å. Solutions in the concentration neighborhood of  $10^{-4}$  to  $10^{-5}$  M quinoline were measured. Purification was effected by fractional distillation for quinoline, and by repeated crystallizations from pure, dry isooctane for the acid. The purification of isooctane and the instrumentation have been described in Part I.

The fact that the optical absorption of a solution of quinoline and trichloroacetic acid was not the same as that of quinoline at wavelengths above approximately 2400 Å, where the acid is essentially transparent, was interpreted

as evidence of complex formation. By using the method of continuous variation, it was indicated that the complex results from the reaction:  $Q + A = QA$ , where Q and A refer to quinoline and trichloroacetic acid and QA represents the 1:1 complex.

Molecular extinction coefficients and the equilibrium constant of the reaction were calculated both algebraically and graphically. The association constant of the complex was found to be  $1.2 \times 10^4$  at  $30.0^\circ\text{C}$ , with concentration units of moles per liter. The magnitude of this constant leads one to believe that a complex of definite chemical composition is formed in the solution and that it is the presence of this substance, rather than a general solvent perturbation, that accounts for the spectral phenomena observed. Microfilm \$2.00; Xerox \$5.60. 115 pages.

VIBRATIONAL RELAXATION TIME STUDIES  
ON CARBON MONOXIDE BY THE INFRARED  
SPECTROPHONE METHOD

(L. C. Card No. Mic 58-3055)

Walter Denny Jones, Ph.D.  
Oregon State College, 1958

Supervisor: J. C. Decius

An Infrared Spectrophone has been developed and reported in a previous thesis at this institution by George C. Turrell.<sup>1</sup> Using this instrument he measured the vibrational relaxation time for carbon monoxide as available commercially. The work on carbon monoxide has been continued because current theory predicts that relaxation in carbon monoxide should be highly sensitive to the presence of low molecular weight impurities, such as hydrogen or helium, and since commercial carbon monoxide contains up to several per cent hydrogen.

The Schwartz-Slawsky-Herzfeld<sup>2</sup> theory for calculating vibrational relaxation times is discussed and modified somewhat to apply to high energy vibrational transitions as are involved in the vibrational relaxation of carbon monoxide. The theory is then applied to the prediction of relaxation times of carbon monoxide in mixtures with hydrogen, helium, neon, and argon.

The processes of energy transfer within the spectrophone cell are discussed on the basis of a heat flow problem, assuming this to be more applicable to the case of carbon monoxide than the creation of a sound wave. An expression for the phase shift is derived and found to consist of a relaxation term and a heat conduction term. Numerical values are substituted to demonstrate that, for the experiments under discussion, the heat conduction term is not significant.

Measurements were made on carbon monoxide in mixtures with hydrogen, helium, argon, and neon and are tabulated. These are analysed to obtain relaxation times corrected to one atmosphere of relaxing gas. It was found that small amounts of hydrogen or helium are important in determining the relaxation time of carbon monoxide. The effect of mass in relaxation processes is discussed. Using present values for the relaxation times for carbon monoxide-carbon monoxide and carbon monoxide-hydrogen collisions and the known concentration of hydrogen in the carbon monoxide used by Turrell, a relaxation time is

calculated for this gas and found to be in excellent agreement with his value. Microfilm \$2.00; Xerox \$4.40. 85 pages.

1. Turrell, George Charles. Determination of the vibrational lifetime of carbon monoxide by the spectrophone method. Doctoral thesis. Corvallis, Oregon State College, 1954. 82 numbered leaves.

2. Schwartz, R. N., Z. I. Slawsky, and K. F. Herzfeld. Calculation of vibrational relaxation. *Journal of chemical physics* 20: 1591-1599. 1952.

#### STUDIES ON THE NATURE OF VOLTAMMETRIC ELECTRODE PROCESSES

(L. C. Card No. Mic 58-3692)

Alan Frederick Krivis, Ph.D.  
University of Michigan, 1958

The importance of uranium in the utilization of atomic energy has stimulated investigation of the analytical chemistry of that element. Among the important aspects of the latter area are the polarographic determination of uranium, the use of cupferron as a separating agent, and the use of complexers for uranium in its different oxidation states.

Polarographic reduction of uranium(VI) to uranium(V) is very sensitive to both the type and the concentration of anion present, as well as to complexation. Therefore, a study of the U(VI)-U(V) reduction in complexing (sulfate and cupferron) and noncomplexing (perchlorate) media was undertaken, using the high ionic strength solutions typical of analytical procedures. Particular attention was given to the effect of experimental conditions on the rate of disproportionation of U(V).

In perchloric acid solution, increasing the perchlorate concentration produced  $E_{1/2}$  shifts which seem to correspond to junction potential effects. Increasing either perchloric acid or perchlorate concentrations increased the rate of disproportionation of U(V). The presence of sulfate shifted  $E_{1/2}$  due to formation of the uncharged 1:1 complex,  $UO_2SO_4$ ; sulfate does not seem to complex U(V).

Kinetics of the successive electroreduction in sulfuric acid solution of uranium(VI) to U(V) to U(IV) to U(III) were measured using sinusoidal wave alternating current polarography. The rate constant and transfer coefficient data indicate the reduction of U(VI) to U(V) and of U(IV) to U(III) to be reversible, and that of U(V) to U(IV) to be irreversible.

Polarography of the uranyl-cupferron system in 10% sulfuric acid solution gave two waves at low uranium and cupferron concentrations corresponding to the U(VI)-U(V) and cupferron-phenylhydrazine reductions. Variation in height and  $E_{1/2}$  of these two waves with increasing uranium and cupferron concentrations are basically related to formation of an insoluble film of U(IV)-cupferrate at the mercury surface. Film formation was verified by experiments in the presence of a known solvent for the U(IV)-cupferrate.

In order to study the uranyl-cupferron system at potentials more positive than those possible with the dropping mercury electrode, the graphite indicating electrode was investigated. Results indicate that the latter cannot be used in mineral acid solution because of solution penetration into the graphite and consequent poor reproducibility. In addition, no uranyl reduction was observed. However, the advantages of the graphite electrode prompted a fuller study of its applicability. Organic oxidations are sat-

isfactorily measured, if experimental conditions and techniques are rigidly maintained constant.

Electrolysis at constant current (chronopotentiometry) at a graphite electrode gave poor results with inorganic reductions; but much better results with organic oxidations. Anodic chronopotentiometric studies of the isomeric phenylenediamines and dihydroxybenzenes indicate the different mechanisms involved. Quantitative analyses of dihydroxybenzene mixtures may be performed with an accuracy of 2% or better. Microfilm \$2.00; Xerox \$6.80. 143 pages.

#### HETEROGENEOUS EQUILIBRIA IN THE SYSTEMS $Na_2O$ or $Na_2CO_3$ - $Nb_2O_5$ , $KNbO_3$ - $NaNbO_3$ and $KTaO_3$ - $KNbO_3$

(L. C. Card No. Mic 58-2876)

Arnold Reisman, Ph.D.  
Polytechnic Institute of Brooklyn, 1958

Adviser: Ephraim Banks

A survey of the literature revealed that little was known about the heterogeneous equilibria in the system  $Na_2O$ - $Nb_2O_5$ . In addition the nature of the interactions in the system  $KNbO_3$ - $NaNbO_3$  were ambiguous because of difficulties relating to the polymorphism of  $NaNbO_3$ . Differential Thermal Analysis, X-ray analysis and density measurements were employed to study the described systems, as well as the polymorphic behavior of  $NaNbO_3$  and  $Na_2CO_3$ . The solid system  $KTaO_3$ - $KNbO_3$  was investigated using the same methods to serve as a comparison for the  $KNbO_3$ - $NaNbO_3$  interaction.

Four intermediate compounds are generated in the  $Na_2O$ - $Nb_2O_5$  system. The base to acid ratios of the compounds are (I) 1:14, (II) 1:4, (III) 1:1 and (IV) 3:1. Compounds I and II melt incongruently at  $1309^\circ$  and  $1277^\circ$  respectively. Compounds III and IV melt congruently at  $1422^\circ$  and  $997^\circ$  respectively.  $NaNbO_3$  (III) was found to exist in four distinct polymorphic forms with first order transformations at  $354^\circ$ ,  $562^\circ$  and  $640^\circ$ . The ambiguities concerning the  $\beta$ - $\gamma$  inversion at  $562^\circ$  can be attributed to the extreme strain sensitivity of the compound.  $Na_2CO_3$  was found to exhibit first order transformations at  $355^\circ$  and  $485^\circ$ . Studies of this compound, after melting in air, showed the appearance of a further transformation at  $288^\circ$  which can be attributed to  $Na_2O$  impurity. These obviate the results of an earlier study of the system  $Na_2CO_3$ - $K_2CO_3$ .

The system  $KNbO_3$ - $NaNbO_3$  was found to exhibit continuous solid solution formation in its liquidus region. The solid interactions were also of the solid solution variety, with no indication of miscibility gap formation. The  $\gamma$  phase of  $NaNbO_3$  was found to form a closed loop field characteristic of iron systems. In order to account for the absence of gap behavior, a distinction is drawn between structural and interaction isomorphism. It is postulated that a change, antiferroelectric-ferroelectric state occurs discontinuously as K is substituted for Na.

The system  $KTaO_3$ - $KNbO_3$  was found to exhibit ideal solid solution interaction throughout the entire compositional range, notwithstanding non isomorphism of the end members. The  $KNbO_3$  transitions are lowered approximately 7% mole% addition of Ta, with indications that the transformations become second order.

Microfilm \$2.00; Xerox \$5.40. 108 pages.

THE PREPARATION OF A POLYMER  
WITH  $\alpha$ -AMINO ACID SIDE CHAINS  
AND ITS CHELATION EQUILIBRIA  
WITH COPPER(II)

(L. C. Card No. Mic 58-2882)

Emil G. Sammak, Ph.D.  
Polytechnic Institute of Brooklyn, 1958

Adviser: Herbert Morawetz

Few synthetic polyampholytes have been described in the literature, and even less is known about polyelectrolyte chelation. The objective of this work was to prepare a polymerizable amphoteric monomer and to study the chelation behavior of its polymer with copper(II) ions.

N, $\epsilon$ -Methacrylyl-L-lysine (MAL) was obtained in the crystalline state through reaction of methacrylyl chloride with the copper chelate of L-lysine. In this way, only the  $\alpha$ -amino group was blocked. Solution polymerization gave a polymer (PMAL) which was characterized by light scattering (weight average molecular weight 281,000) and by its titration behavior.

Valine was used as a monomeric analog because its copper(II) chelate is relatively soluble; the chelate formation constants are insensitive to the length of the aliphatic substituents; and visible spectra of several amino acid chelates were shown to be superimposable. Molar extinction coefficients of the monochelate and dichelate of valine were carefully determined by three procedures with special attention to the region of the maxima (600 and 700 m $\mu$  respectively). The molar extinction coefficients for the valine chelates were assumed identical to those of the PMAL chelates.

Spectra of polymer solutions containing small concentrations of copper(II) were then used in calculating concentrations of mono- and dichelates of PMAL. Certain inconsistencies in the PMAL data suggest the presence of a small amount of trichelate which was not taken into account in the calculations. There also may be a medium effect on the absorption spectra.

PMAL is a much more effective chelating agent than the monomeric analog under all conditions of concentration and pH. The polymer had a much higher tendency to form the dichelate, but the PMAL monochelate concentration was also usually much greater than with valine. Strikingly, the concentration of dichelate increased considerably on addition of water while the proportion of monochelate decreased in the normal manner.

Chelation behavior in the presence of an excess of copper was studied briefly by titration with base. Surprisingly, nearly all the bound copper was in the form of dichelate at the end point. This was in contrast to the fact that the spectra had shown appreciable amounts of the monochelate when less than half the ligand groups were neutralized by base.

The results were discussed in terms of the electrostatic field of the PMAL coil, configurational effects and group interactions. The changes in monochelate concentration clearly show that the ratio of ligand groups to copper(II) ions within the polymer coil is not altered by dilution or by changing their relative stoichiometric concentrations. The marked increase in dichelate concentration on dilution can only be explained by the inter- or intramolecular disengagement of associated ligand groups. The fact that the

polymer forms the monochelate more readily than valine even below its isoelectric point, when electrostatic repulsion should hinder complex formation, has not found an adequate explanation.

The study proves that chelate rings much larger than those encountered in chelation studies of low molecular weight substances can lead to a substantial increase in the stability of cation complexes with polymers carrying many ligand groups. Microfilm \$2.75; Xerox \$9.20. 209 pages.

TITANIUM AND ZIRCONIUM AS  
ELECTRODES FOR PRIMARY CELLS

(L. C. Card No. Mic 58-3061)

Milton Avery Thompson, Ph.D.  
Oregon State College, 1958

Major Professor: Allen B. Scott

Practical commercial methods have recently been developed to produce titanium and zirconium. Because of their high strength and melting points these metals find useful application as structural materials and in high melting alloys. It has been suggested that additional application might be found as battery electrodes. The nature of this project was to explore the possibility of using these metals as anodes in a primary cell.

Preliminary studies were made on corrosive properties of the metals. Polarization was investigated in possible electrolytes by the direct method. Faraday's Law measurements were made to gain information on the electrode process and polarization products. Cathodes were investigated for their suitability in the promising electrolytes, and, finally, actual cells were constructed and their characteristics noted.

The most satisfactory electrolyte found for titanium contained between 0.075 and 0.1 N hydrofluoric acid, between 4% and 8% ammonium fluoride, and 0.1 N potassium chloride. Single electrode potentials of the order of -1 V were obtained as compared to -0.7 V for zinc in a normal LeClanché cell electrolyte.

The most satisfactory cathode was lead dioxide although it was not satisfactory in the above electrolyte. Voltages of 2.5 V were obtained from a cell containing a titanium anode in a 0.075 N hydrofluoric acid, 6% ammonium fluoride, 0.1 N potassium chloride electrolyte and a lead dioxide cathode in a sulfuric acid (Sp.G. 1.1) electrolyte. When drawing current at about 2 ma/cm<sup>2</sup> at the anode, the cell voltage dropped to two-thirds of its original value in 21 hours as compared to 15 hours for a comparable decrease in a flashlight size LeClanché cell.

Excessive corrosion of the titanium resulted when the two electrolytes were combined, but was appreciably slowed by additional ammonium fluoride. The cell voltage decreased by about 0.25 V in the combined electrolyte, and the cell characteristics were not as good because of the action of the fluoride solution on the lead dioxide.

Excessive corrosion resulted when zirconium was used in the fluoride solution and no satisfactory electrolyte was found for this metal.

Microfilm \$2.00; Xerox \$5.60. 113 pages.

## ECONOMICS

### ECONOMICS, GENERAL

#### REGIONAL INPUT-OUTPUT ANALYSIS OF AGRICULTURE AND INDUSTRY

(L. C. Card No. Mic 58-2989)

Harold Ola Carter, Ph.D.  
Iowa State College, 1958

Supervisor: Earl O. Heady

This study was an application of regional input-output analysis to the United States economy in 1954. Primary emphasis was on agriculture.

Agriculture was divided into ten type-of-farming regions. Nine agricultural commodity groups were identified in each region. Industry was aggregated "nationally" into a) seven agricultural processing sectors, b) five agricultural furnishing industries and c) one sector to represent "all other industries".

Direct dependence between agriculture and industry was indicated by input-output coefficients. Input-output coefficients show the amount of output required from sector i per dollar of output of sector j. A dollar of agricultural output required 32 cents of industrial inputs. Industry required five cents of agricultural inputs per dollar of output. However, a dollar of output from agricultural processing industries required 36 cents of agricultural inputs--approximately the farmers' share of the consumers' food dollar.

The Northeast Region purchased the most inputs from non-agricultural sectors per dollar of agricultural production. Industrial purchases were relatively high in the Northeast Region because 1) it is a deficit feed producing region requiring shipments of commercial feeds from other areas and 2) high protein formula feeds are needed for predominantly dairy and poultry enterprises. In contrast, industrial inputs, i.e., fertilizer, chemicals, machinery, etc. per dollar of agricultural output were lowest in the Mountain States where native grasses are the primary inputs for range cattle and sheep.

Interdependence coefficients show the amount of gross output required from sector i per dollar of output of sector j delivered to final demand. The Corn Belt would need to increase gross output by 15 cents to meet delivery of one dollar of agricultural processing goods outside the system, more than twice the required increase in output for any other single region.

Farm inputs and outputs needed to meet projected 1960 and 1975 final demands for agricultural processing industries were estimated. Projected demands for agricultural goods for 1960 indicate a required volume of farm output about seven percent greater than in 1954, and a required volume of industry output approximately two percent greater than in 1954.

Estimates for 1975 showed that gross farm output would need to be 28 percent greater than in 1954 and that

industry output would need to be about six percent greater than in 1954.

The limitations of input-output analysis as related to agriculture are reviewed. Chief limitations are the fixed and linear production coefficients used to describe and analyze relationships between sectors in the model. Lack of adequate data is also a major restriction in constructing input-output tables.

However, even with these restrictions input-output analysis is a useful technique for analyzing and quantifying the interdependence between agriculture and industry. Microfilm \$3.80; Xerox \$12.80. 295 pages.

### CASE STUDIES IN PHARMACY MANAGEMENT

(L. C. Card No. Mic 58-3667)

Floyd Alfred Grolle, Ph.D.  
University of Michigan, 1958

The case method of instruction has been used with success for many years in law, medicine and business administration. The method is also applicable in the field of pharmacy management, but has not been used to any appreciable extent in pharmacy because of the lack of suitable illustrative materials. Development of some of these materials has been the objective of this study.

A list of thirty significant business problems of pharmacy managers was prepared, and an attempt was made to secure financial, managerial and personal data pertinent to each problem in sufficient detail to provide adequately for preparation of an abbreviated case history.

A total of 156 pharmacies was visited throughout various sections of the United States, and 258 key persons were interviewed. In twelve instances the managers or owners furnished information adequate for the preparation of cases. In several other instances pharmacists were willing to cooperate, but the data furnished proved to be inadequate for even an abbreviated case history of acceptable nature.

Two examples (chapters 1 and 2) were obtained dealing with purchasing a pharmacy--in one instance in partnership and in the other as a sole owner. The third case deals with problems arising from selection of a poor location by an owner-manager having inadequate business experience. The problems arising from a prescription business in a new medical building are outlined in chapter 4. The fifth case deals with a pharmacist facing the possibility of competition from a pharmacy proposed in a nearby medical clinic. A pharmacist's desire to expand his business and stabilize its location through purchase of a building is covered in the sixth case.

Chapter 7 deals with the problem of modernizing a pharmacy to meet competition from two new drugstores. Policies governing prescription pricing and related

business policies in an exclusive prescription pharmacy are discussed in the eighth case. Credit and collection procedures necessary to the profitable extension of credit in a pharmacy are dealt with in the ninth case. Two cases are included on insurance. The first of these covers the funding of a purchase agreement with partnership life insurance. The second insurance case involves inadequate provision against loss from fire. The last of the twelve cases discusses an agreement between a small community hospital and a retail pharmacy in order to provide adequate pharmaceutical service to the hospital.

Several impressions concerning the business inadequacies of many pharmacy owners and managers resulted from these studies. The impressions were strengthened by unsuccessful attempts to secure data adequate for cases on other phases of pharmacy management. The twelve abbreviated case histories and the larger number of studies whose completion was prevented by inadequate data or through reluctance to make the sources of information available point to a number of business deficiencies on the part of managers of pharmacies. These deficiencies are so widespread as to emphasize strongly a need for in-service training in modern business practices, and for continuing curricular emphasis on pharmacy administration for future pharmacists.

The following factors appear to be in need of attention from many managers of pharmacies:

1. Allocation of items of expense and overhead to specific departments or operational activities.
2. Development and application of sound practices in personnel relations.
3. Apportionment of earnings among such competing demands as future expansion and adequate salaries.
4. Realistic appraisal of existing and potential competition.
5. Credit policies and practices.
6. Inventory control as related to operating capital and sales.
7. Public and professional relations.
8. Balancing of such assets as real estate, equipment, and fixtures in relation to available capital.
9. Adequate insurance coverage.

Despite the obvious difficulties in obtaining material satisfactory for the preparation of case histories, the case method of instruction holds real promise for the field of pharmacy management.

Microfilm \$3.85; Xerox \$13.00. 297 pages.

#### LINEAR PROGRAMMING OF DYNAMIC PLANS FOR AN ACTUAL FARM AND HOUSEHOLD

(L. C. Card No. Mic 58-3005)

Laurel Duane Loftsgard, Ph.D.  
Iowa State College, 1958

Supervisor: Earl O. Heady

The economics of farm and home planning on an individual farm in Dallas County, Iowa were analyzed by application of linear programming techniques. All information required in the programming models was based

on empirical data from the case farm and geared to expectations in the planning framework of the farm family.

Past input-output data for the case farm included farm cost accounts, feed records, labor records and crop yields for various fertilizer treatments. The majority of items in cost accounts were recorded as total figures for the farm rather than allocated to each enterprise. A method of successive approximations was used to impute these values to each enterprise.

In addition to simplex programming solutions, modified simplex methods were employed to determine optimum resource use for particular farm situations.

A method of varying input-output coefficients was used to establish stability of optimum crop rotations with respect to yield fluctuations. A second modification in the programming model permitted the formulation of price maps. These maps illustrated the price stability of various livestock combinations when selling prices for hogs and beef were varied and corn price was held constant at three different levels. A method of dynamic programming gave optimum farm plans for eight successive years. Yearly expansion of these plans related to the magnitude of augmenting annual supplies of operating capital. The added or initial investment for any one year equaled farm returns of the previous year minus fixed charges that included family living expenses projected by the farm family.

In comparison to past operations on the case farm, programming solutions consistently indicated: increased profits result from expanding hog production, and; optimum land use requires an increase in corn acreage, and rotations with two years of meadow to supply forage for livestock. Past forage needs have been supplied from crop rotations with only one year of meadow.

Several unique problems inherent in programming applications to individual farms were exposed. Major difficulties were involved in establishing relevant input-output data and quantifying subjective facets of the family's planning frame-work.

It is believed that special record forms would be a useful prerequisite for parallel studies. Input-output data would be recorded in these forms for each enterprise. General cost items could be imputed to each enterprise at periodic intervals throughout the year. An auxiliary aid would be an educational process that explains the fundamentals of programming. This step would provide the farmer with an understanding of the format required for data and the nature of programming results.

Microfilm \$2.00; Xerox \$6.00. 124 pages.

#### FARM AND NONFARM ADJUSTMENT OPPORTUNITIES FOR SPECIFIED RESOURCE SITUATIONS FOR FAMILIES ON SMALL OWNER-OPERATED FARMS, PIEDMONT AREA, GEORGIA

(L. C. Card No. Mic 58-3016)

Fred Bradley Saunders, Ph.D.  
Iowa State College, 1958

Supervisor: Earl O. Heady

This study was addressed to the problem of evaluating farm and nonfarm adjustment opportunities for families on small owner-operated farms. The specific

objective was to determine optimum plans for families with particular quantities of resources on small owner-operated farms in the Piedmont Area of Georgia. This objective was accomplished by determining profit maximizing plans for typical farm situations. Linear programming procedures were used to compute the optimum plans.

In computing the optimum plans, consideration was given to the types of resources and income opportunities available to families on small farms. The central portion of the analysis is for a farm with 40 acres of open land and 1.5 man-equivalents of labor. However, in order to determine the effects of variations in the amount of land, some analysis was directed to farms with 15 and 60 acres of open land. Also, in order to ascertain the effects of variations in the amount of labor, additional analysis was directed to situations with 2.0 and 2.5 man-equivalents of labor.

Broad types of adjustment opportunities for families on small farms include full-time farming, part-time farming, and full-time nonfarm employment. The farm and nonfarm opportunities considered in this study were restricted to permit evaluating and making income comparisons between each of these three types of adjustment opportunities. Hence, the optimum plans are grouped under one of these types of adjustments.

Results of this analysis lend support to the following conclusions: (1) Families on these small farms can make profitable adjustments within agriculture provided restrictions on the amounts of capital available for additional investments can be removed or greatly reduced. (2) These adjustments will require either (a) an intensification of operations on given land areas and/or (b) an expansion in farm size. (3) Many families on small farms that do not have ample amounts of investment capital must shift to nonfarm employment. (4) However, unless these families have absolutely no capital to invest in agriculture and unless they have employment opportunities at a nonfarm wage rate of \$1.50 or above, this shift to nonfarm opportunities should not be a complete one. (5) Consequently, under present nonfarm employment conditions, many families on small farms can profitably engage in part-time farming and, thus, allocate resources to a combination of farm and nonfarm activities.

Microfilm \$2.95; Xerox \$10.00. 225 pages.

#### ASPECTS OF THE THEORY OF NORMATIVE ECONOMICS

(L. C. Card No. Mic 58-2937)

Leslie Paul Singer, Ph.D.  
Indiana University, 1958

The Theory of Normative Economics is defined as the study of the relationships between positive economics and ethics. A division of labor is maintained between the economist and the moralist. The former is principally concerned with explanation and prediction; the latter with the moral judgments that move men.

The axiologists in ethics emphasize concepts of value, such as goodness, more than concepts of obligation such as rightness. In practical situations where the economist is asked to assist the moralist in specific

choice situations, a middle ground must be found between the axiologist and the deontological deontologist (the latter consistently denies that the goodness of consequences is a criterion of rightness). Moral judgments are based on some objective characteristics which are the Identifying Properties of the Judgment. The latter lend themselves to teleological analysis by economists. However, there are always residual elements which cannot be analyzed scientifically. These are often determined by the cultural patterns of peoples: that is, some judgments concerning the "rightness" of means are ontological.

An appropriate methodology begins with Conceptual Analysis: an abstract frame of reference consisting of models, each expressing the a priori probability for obtaining the moralist's goals. Using a system of weights, the economist can indicate how nearly the goals can be approached. In addition, by multiplying the probabilities by their respective weights, he achieves an hierarchical ordering of conceptual models.

Since human behavior is characterized by a random distribution of reactions, an ex post study of the relative frequency of types of reaction may be used in support of predictions. We assume that consumers are faced with unsure prospects when buying commodities. The proposition is introduced that if the consumer buys a product he expects to experience an unspecified type of satisfaction "x" with a probability "P." His expectation is based on his past experience with a specific brand or a specific outlet and is modified by a learning process. If "x" occurred  $n_1$  times in  $n$  trials, the consumer will consider the relative frequency  $n_1/n$  as the best estimate of "P", the probability of experiencing "x" in an infinite number of trials. But consumers may not want to experiment; rather they will buy brand names advertised over mass media. Large sellers who are potential monopolists or oligopolists may encourage this attitude on the part of the consumer and may even develop special techniques of persuasion. Diversions from the ethical optima of ideal utilitarianism may occur.

Once we leave the quasi scientific domain of the utilitarians and consider the fact that men make judgments concerning what they consider "fitting" in a certain general situation, we have to combine consequential analysis with a set of the priorities which the moralist obtains on the basis of a phenomenological analysis of the moral consciousness of mankind. The predictions of economists can be fitted into a matrix of stochastically dependent conditional probabilities. Each element is an estimate of the probability of A (say, that the level of unemployment will not exceed 4% of the defined labor force in time "t") given the probability of B (say, of flexible prices in factor and product markets).

The conclusion is reached that provided a clear separation of intentions and purposes is maintained between the moralist and the economist, a unified methodology for the two fields is a definite possibility.

Microfilm \$2.15; Xerox \$7.60. 162 pages.

# THE ECONOMIC IMPACT OF PARTITION ON INDIAN AGRICULTURE AND RELATED INDUSTRIES

(L. C. Card No. Mic 58-2815)

Vir Viranjan Singh Tyagi, Ph.D.  
The American University, 1958

Before partition, the two regions of Undivided India, now called India and Pakistan, were economically complementary to each other. Pakistan supplied most of the raw materials to the industries located in India. The partition of the subcontinent created severe dislocations and hardships and affected all aspects of the economic life of India.

The communal riots which immediately followed the partition resulted in a mass migration from both countries across the border, increasing the population of already crowded India by about 3 million people and creating a vast problem for the relief and rehabilitation of the refugees, which still remains a major problem to the Government of India.

The partition increased the shortage of agricultural commodities and foodgrains in India. Some of the most fertile lands were ceded to Pakistan and the unequal division of the irrigation facilities created a bitter dispute over the waters of the rivers of Punjab.

Another serious result to India of the exchange of population was the loss of many skilled artisans and agriculturists who migrated to Pakistan. This loss of skilled workers disrupted the woollen, hosiery, tanning and many other industries in India. The industrial production was further curtailed by a shortage of raw materials, many of which had previously been supplied by Pakistan.

In case of the Jute Industry, which was solely located in India, the mills had to remain closed for one week in each month for lack of raw materials for a considerable time. Similarly, India retained 96 per cent of the cotton mills but only 60 per cent of the raw cotton production of Undivided India. The woollen and leather industries suffered in the same way from lack of good quality wool and hides, formerly produced in Pakistan.

The Tea and Paper Industries were disrupted mainly by the dislocation of the normal trade routes which came about after the partition and which resulted in cutting off supplies of coal for the tea gardens, and bamboos for the paper industry.

The shortage of raw materials and the dislocation of trade routes seriously reduced the industrial production of India resulting in unemployment, higher prices and misuse of economic resources. It was essential to increase the domestic production of raw materials, but in the face of food shortage there was the difficult choice of producing foodgrains or industrial raw materials on any given piece of land. Production of either commodity could not be appreciably increased immediately and in the intervening period India had to depend upon imports from abroad resulting in large deficits of trade balances which have been further aggravated by the increased imports of capital goods for industrial development.

In Undivided India, Pakistan was an important buyer of the agricultural and industrial products of India. The partition caused a loss of the Pakistan market to India and the Indian industries were forced to locate markets elsewhere.

The emergency measures taken in the First and

Second Five Year Plans have reduced the initial impact of the partition with regard to lack of raw materials, dislocation of trade routes, shortage of skilled labour and loss of market in Pakistan and the agricultural and industrial production of India have now reached, and in some cases surpassed, the level of production in Undivided India. The loss of market in Pakistan has been compensated by the increase in internal consumption and in finding new markets, particularly in the Middle East. However, secondary effects, such as rehabilitation of refugees and deficit in balance of payments, will take a long time before they can be completely remedied.

Microfilm \$3.05; Xerox \$10.40. 234 pages.

## ECONOMICS, COMMERCE AND BUSINESS

### ECONOMIC IMPLICATIONS OF THE GUARANTEED ANNUAL WAGE

(L. C. Card No. Mic 58-2951)

Keith Roger Blunt, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Walter L. Daykin

The guaranteed wage has become a dominant issue in collective bargaining and a leading problem in industrial relations. Since the guaranteed wage presents many questions of a complex nature, the problem involved is to determine whether the device merits serious consideration as an instrument for attaining security. This study assumes that economic aspects of guarantees constitute the basic element for analysis. Economic implications of the annual wage are examined from the points of view of employees, organized labor, individual firms, and economic society in general.

The most obvious effect of the annual wage from the viewpoint of employees is that it may provide greater economic security. A guarantee may also have a positive effect upon the community in which the employees covered by the guarantee reside. A guarantee may have a negative effect upon the job opportunities of part-time workers, young people, and those excluded from the plan. It is also argued that guarantees discriminate against long service employees.

From the viewpoint of organized labor, guarantee plans are likely to expand the scope of collective bargaining. A guarantee may lighten the work load of the union's officers and committeemen and may lead to more mature collective bargaining. However, guarantees may effect some changes in the traditional principles of seniority and may force labor to surrender some previous gains. A guarantee plan may also create various types of internal union strife.

Operating under a guarantee, a firm is likely to experience both benefits and disadvantages. If employees feel more secure this may raise their morale and improve industrial relations. If the guarantee reduces labor turnover it will minimize the loss of skilled personnel and reduce the costs of hiring and training new

employees. To the extent that guarantees raise morale and reduce turnover, there may be a salutary effect on efficiency and productivity, which in turn may offset part of the guarantee costs.

The adoption of a guarantee is almost certain to induce management to exert further efforts toward stabilizing company operations, thereby allowing numerous cost savings to accrue to the company. The net result of these advantages may be to enable management to enjoy reduced costs of operation. These savings may equal or exceed the costs of maintaining the guarantee, and consequently may increase profits for the company.

Critics of the guaranteed wage contend that it would convert a segment of labor costs from a variable to a fixed charge. This may inject undesirable rigidities into business operations. Moreover, guarantee costs are said to be unpredictable, and the employer may not be safe even though he has built up a reserve fund, for if the fund becomes depleted, various forces would demand a continuation of benefit payments despite any limited liability provision.

It is feared that guarantee costs and rigidities arising therefrom may penalize business growth by inhibiting expansion of existing firms and by discouraging the growth of new business. Because of costs involved in compensating displaced employees, it is asserted that guarantees may likewise deter technological improvements. The fact that a guarantee plan divides workers into two groups, namely secure and insecure, may be an impediment to satisfactory personnel relations.

For the economy as a whole it is argued that guarantees would stabilize the volume of employment through their effects on the components of aggregate demand, but the weight of economic opinion does not seem to support this argument. Guarantees may encourage the concentration of economic power by raising the point of optimum output, and by intensifying the efforts of giant firms to keep their work forces employed.

It is feared that desirable labor mobility may be held to a minimum if guarantees become prevalent. While the economic significance of guarantee reserve funds is difficult to assess, they may restrict new investment if they become too large. Finally, it is feared that the degree of stability desired cannot be achieved unless the existing free enterprise system is modified substantially in the direction of a planned economy.

Microfilm \$2.55; Xerox \$8.80. 195 pages.

**STUDIES IN ECONOMIC EDUCATION IN IOWA,  
PART II: A SURVEY OF THE STATUS OF  
ECONOMIC EDUCATION IN SOCIAL STUDIES AND  
BUSINESS EDUCATION IN IOWA ACCREDITED  
PUBLIC HIGH SCHOOLS**

(L. C. Card No. Mic 58-2974)

William John Mason, Ph.D.  
State University of Iowa, 1958

Co-Chairmen: Professor Clark C. Bloom  
Professor William John Masson

The major purpose of this study was to determine the status of economic education in social studies and

business education areas of learning in Iowa's accredited public high schools. The status of economic education was disclosed by answers to the following questions:

(1) What was the status of social studies and business education curriculums, enrollments, and teachers in all of Iowa's accredited public high schools during the school year, 1956-57? (2) What objectives and scope of economic education were held by teachers of economics, American history, problems, American government, and sociology in accredited public high schools in six selected Iowa counties? and (3) What instructional materials and activities were used by teachers of economics, American government, American history, problems, and sociology in accredited public high schools in six selected Iowa counties? The six-county sample was stratified according to per capita income, which gave a rough measure of the ability of each area to support public education. Methods used in securing desired data were (1) inspection and analysis of Daily Program Cards in the files of the State Department of Public Instruction and the Iowa Educational Directory, and (2) personally delivered questionnaires. A Daily Program Card for every Iowa accredited public high school in 1956-57 was inspected and analyzed. Out of a possible 107 teachers in the sample universe selected, 66 returned usable questionnaires.

Factors favorable to a strong economic education program were (1) that a medium existed for economic education as suggested by the presence of social studies and business education in almost every school and the fact that one in five high school teachers was a social studies teacher while one in seven was a business education teacher, (2) that the potential quality of social studies and business education instruction was good as measured by such teaching conditions as pupil-teacher ratios, average class size, number of daily preparations, and number of subject-matter field assignments, (3) that the teachers had specific objectives for economic education, (4) that the teachers suggested a broad scope for economic education, and (5) that teachers used a variety of instructional materials and activities.

Factors that revealed weaknesses in the status of economic education were (1) that relatively few courses were offered in economics, general business, or consumer economics and, hence, few students received opportunities for economic education in such courses, (2) that the eleventh and twelfth grades were already crowded with business education and social studies subjects, and (3) that the absolute and relative number of pupil semesters and schools offering identifiable courses in economics were rapidly declining.

A need exists for determining the quantity and quality of economic content that is integrated in other social studies and business education subjects.

Microfilm \$5.20; Xerox \$18.60. 407 pages.

**AN EVALUATION OF THE USEFULNESS AND  
LIMITATIONS OF ACCOUNTING DATA ADJUSTED  
FOR PRICE LEVEL CHANGES**

(L. C. Card No. Mic 58-2939)

Henry M. Steele, Ph.D.  
Indiana University, 1958

One of the most debated issues in accounting since World War II has been the price level problem. Areas of research and numerous articles in the literature have dealt primarily with concepts of income and its measurement, methodology for effecting adjustments, inventory and fixed asset accounting, utility regulation, taxation, and case studies. Any justification for adjusting accounting data for price level changes must be based on the usefulness of the adjusted data. If these figures are useful, they should not be applied without full recognition of their inherent limitations. The purpose of this dissertation is to evaluate the usefulness and limitations of these data from the viewpoint of management, investors, government, economists, and labor.

The literature was surveyed to determine prior views and current thinking on the problem. An interview guide was then prepared as an aid in determining the views and reactions of users and potential users of adjusted data, the problems which confront them, and the form and type of data which would be most valuable for their own unique problems. Personal interviews were conducted among corporation executives, investment analysts, economists, and labor representatives.

Except for the effects from price level fluctuations, the limitations of conventional accounting data apply also to adjusted data. Price level adjustments do not make allowance for changes in technology, which is one of the most pronounced limitations of uniform dollar figures. Adjustments are based on index numbers, which, being sample averages, may contain all the inaccuracies of any statistical estimate. Data adjusted for price level changes reflect neither replacement costs nor physical volume change in sales unless, by chance, costs and sales prices respectively have changed by the same relative amount as the index used for adjustments; this is not a defect in adjusted data, but needs recognition in their application. Usefulness of the data to non-managerial groups would be limited by lack of uniformity in the methodological techniques. Reconciliation of statements, applicability, and timeliness of adjusted reports were among other limitations considered.

The principal application of adjusted figures is to distinguish between real income and recovery of real capital investment. Many of the uses considered are closely related to this function. Managerial applications were viewed primarily in terms of price policy, dividend policy and stockholder relations, wage negotiations and employee relations, capital budgeting, and government control and negotiations. It was concluded that applications for pricing purposes were limited, but that in the area of dividend policy and stockholder relations there was a great potential usefulness. Use of adjusted data during wage negotiations would be restricted largely to the higher levels of collective bargaining. Capital budgeting and government control offer potential applications. Problems of investment analysts included analyses of comparative statements and financial structure, determination of rate of return,

and the distinction between price fluctuation profits and management action profits. Potential usefulness to the government involved such areas as taxation, counter-cyclical policy, utility regulation, and contract renegotiations. Problems of the economists were quite diverse, including such applications as the compilation of national income statistics, distributive share analysis, allocation of resources, and analysis of comparative statements. Labor groups have not been favorably disposed toward price level adjustments, but potential applications for their studies of income allocation and for wage negotiations were considered. Contingent upon improvement and standardization of methodological techniques, there is a great potential usefulness of accounting data adjusted for price level changes.

Microfilm \$3.75; Xerox \$12.80. 292 pages.

**ELECTRIC RETAIL RATE INCREASES AND  
FARMERS' USE OF ELECTRICITY**

(L. C. Card No. Mic 58-2816)

Robert Burns Williamson, Ph.D.  
The American University, 1958

This is a study of the elasticity of farmers' demands for electric energy, with emphasis upon the effects of rate increases. The major questions investigated were: (1) the general slope of the demand curve, (2) conditions affecting elasticity, and (3) factors determining the level of farmers' demands. The investigation included a review of past studies and original statistical analysis.

There were basically two statistical methods used to secure indications of the relationship between electric rates and quantities demanded. One was a correlation analysis of rate and use levels during 1954, holding constant the major influences on strength of demand. The other approach was to study the effects of rate increases on consumption trends over the period 1949-1954. The utility systems comprising the samples were Rural Electrification Administration borrowers located in the central and north central parts of the Nation.

One analysis showed that average monthly use per farm consumer decreased about 33 kilowatt-hours for each cent per kilowatt-hour increase in rates. Another analysis showed that, for a group of systems which raised rates an average of 10 percent, electric use per consumer was only 6 percent below the normal trend line five years following the rate increases.

Important conclusions indicated by the study were: (1) farmers' demands for electricity have been generally inelastic at rate and consumption levels prevailing in recent years; (2) within the usual range of rates, demands are more inelastic for the first quantities of electricity than for additional amounts; (3) availability of competitive fuels affects elasticity of demand, especially at the higher consumption levels; (4) high-income consumers have more inelastic demands, for particular types and levels of electric use, than do consumers with low incomes; and (5) income and other factors have far greater influence on levels of consumption than do the ordinary rate differentials.

According to the findings, the type of rate changes that

would bring the greatest gross revenues for most of the systems studied would be price increases for the first blocks of the rate schedule and the adjustment of special cooking and water-heating rates to levels just below other fuel prices. Microfilm \$2.00; Xerox \$6.20. 128 pages.

## ECONOMICS, FINANCE

### SUCCESSION DUTIES IN CANADA

(L. C. Card No. Mic 58-2919)

James Wilson Johnston, Ph.D.  
Indiana University, 1958

The purpose of this study is to describe and to analyze succession duties--or death taxes--as they have operated under provincial and Dominion legislation in Canada.

The first succession duty in Canada was introduced by Ontario in 1892. Other provinces followed shortly after and adopted the form of the Ontario act for their tax. The Dominion act, introduced in 1941, was of the same type. Thus, all of the succession duties in Canada are of a similar composite form. The initial rate of the tax is based upon the total size of the decedent's estate as is an estate tax, but is also based upon the relationship of the legatee to the decedent as is an inheritance tax. The additional rate, like an inheritance tax, is based upon the size of the individual bequest and the relationship of the legatee. The two rates are combined to give the tax rate; then, under Ontario and Quebec laws, but not under the Dominion law, a surtax which is based on the relationship of the legatee is applied.

Today, only two provinces, Ontario and Quebec, continue to levy succession duties; the others have "rented" the death tax field to the Dominion by agreement in return for annual payments. Thus, a considerable degree of coordination has been achieved and multiple taxation has been lessened because for most of Canada there is only one taxing authority in the field.

Court decisions declared the provincial succession duties to be within the taxing power of the provinces as described in the British North America Act of 1867 which had united the provinces. British precedents aided in the court interpretations of early provincial acts. For instance, the maxim, *mobilia sequuntur personam*, was adopted from the United Kingdom and Canadian courts declared that the personal property had the domicile of the decedent and was taxable there. Similarly, court decisions determined the situs for taxation purposes of many types of property. Practice and decisions brought many similarities in the legal treatment of the taxes, but as early as 1916 there were attempts to seek uniformity of legislation.

The major achievement in reducing double taxation has been the tax rentals system which grew out of the wartime taxing agreements. By 1947, all of the provinces except Ontario and Quebec had signed tax agreements with the Dominion which included the surrender of the succession duty field. In 1952, Ontario signed a tax agreement but retained its own succession duty.

There has been considerable progress towards relieving double taxation and other inequities. However, problems remain. There is the unequal incidence of the Dominion tax between the provinces as it applies in Quebec which recognizes community property and as it applies elsewhere in Canada. Generally speaking, in Quebec only one-half of the estate is taxed in a transfer between spouses. There are questions of beneficiaries, rates, and exemptions as the taxes affect a greater proportion of a population which is growing in wealth. As well, there is the future of the tax agreements to consider and the form of the Dominion tax itself.

Microfilm \$3.55; Xerox \$12.00. 273 pages.

### THE EFFECT OF PERSONAL EXEMPTIONS ON THE INCOME TAX STRUCTURE

(L. C. Card No. Mic 58-3233)

Michael E. Levy, Ph.D.  
Columbia University, 1958

This study provides an extensive and systematic analysis of income-tax exemptions and tax-rate changes with special emphasis on the impact on the average tax rate, the degree of tax progressivity, and incentives to work. General economic theory is applied to specific features of income taxation in order to derive broad generalizations of wide applicability without either getting lost in the rich variety of institutional detail or becoming entangled in non-economic normative problems. Whenever possible, United States federal income tax data are used in order to provide empirical content, illustrate certain points of the analysis, or serve as the foundation for more specific conclusions.

In Chapter I, three "rationality criteria" are postulated which have to be met by any modern income tax in order to make it a "good", or generally acceptable, tax. The three basic types of exemption (initial, vanishing, and continuing) are then set forth and subjected to the test of the "rationality criteria". There result certain restrictions with regard to the types of exemption and tax rate structure which are admissible.

In Chapter II, those "admissible" exemptions are analyzed with regard to their absolute and relative value to the tax-payer under proportional taxation and their impact on the average tax rate and on tax progressivity. Thereafter, changes in the parameters of the proportional tax (that is, changes in the rate of decline of the exemption, the proportional tax rate, and the maximum size of the exemption) are considered. This analysis of proportional taxation serves as the basis for the more complex analysis of progressive taxation.

The discussion in Chapter III and IV, dealing with progressive taxation, is limited to the most common type of exemption--the continuing exemption. In Chapter V the analysis of progressive taxation is then extended to cover the vanishing exemption and the two basic types of "quasi-exemption": the tax credit and the standard deduction.

Chapter III presents an analysis of the continuing exemption under progressive taxation. Thus, it is an extension of Chapter II. Of particular interest are Sections D and E. Section D deals with the transformation of the

progressive tax into a series of proportional tax-bands with (bracket-) exemption. This device greatly facilitates the analysis. In Section E, overall rate changes are classified into three basic types which permit interesting generalizations with regard to their impact on the average tax rate and on tax progressivity. Extensive use is made of graphic presentation.

In a certain way, Chapter IV may be considered the heart of the study. It draws on many tools and generalizations of the preceding analysis in order to compare statutory revenue changes due to changes in the size of the exemption with those due to rate changes. The various effects and differences of these two types of statutory revenue adjustments are discussed. Of particular interest is the analysis of incentive effects in Section D. It contains a new and original approach which represents an important extension of the traditional indifference curve analysis of incentive effects.

Finally, Chapter V deals briefly with the vanishing exemption under progressive taxation and with the two basic types of "quasi-exemption", that is, the tax credit and the standard deduction. The analysis of these "quasi-exemptions" is probably the most comprehensive one available.

Mathematical Appendices to the various chapters provide the mathematical proofs for the generalizations and conclusions in the text.

While a number of new and interesting analyses and conclusions arise in the course of this study, its main value lies in the thorough and comprehensive way in which it scrutinizes the effects of the various types of income tax exemption on the tax structure.

Microfilm \$2.50; Xerox \$8.80. 191 pages.

#### MONETARY POLICY AND THE RECESSION OF 1953-1954

(L. C. Card No. Mic 58-2924)

Harry David Maloney, Ph.D.  
Indiana University, 1958

Although informed observers are now familiar with monetary policy formation and execution, disagreement exists regarding the effects of monetary actions on output, employment and price levels. When central bank actions are taken, subsequent developments are often offered as evidence of the supposed effects of the actions. It is assumed in this study that the effects of monetary actions can be discovered only through a detailed investigation of all of the major relevant factors during a specified period. In this investigation of the effects of Federal Reserve actions the period 1953-1954 was chosen. This was a period during which restrictive actions were followed by a decline in output and employment and by generally stable price levels.

The economic aspects of the 1953-1954 period cannot be understood without investigation of the Korean War defense program and its effects. The early months of the war saw a substantial inflationary movement which reached a peak in the early weeks of 1951, following which consumer and wholesale price levels were stable. Meanwhile, during 1951 and 1952, the partial mobilization effort had diverted a substantial part of the national prod-

uct into national security channels. Despite the fact that the inflationary expectations of 1951 and 1952 did not materialize the Federal Reserve authorities carried out a restrictive policy during the last half of the latter year and the early months of 1953.

In 1953 a new administration soon made clear that its announced goals of lengthening the maturity of the federal debt and pursuing a "flexible" interest rate policy would be implemented. A series of debt-refunding steps by the Treasury indicated that it was willing to permit and encourage a general increase in market interest rates on outstanding and forthcoming government security issues. These steps culminated in a 3 1/4 per cent bond issue which was offered to the public on April 1. This issue, together with the tight conditions created by Federal Reserve actions, produced a marked temporary tightening of credit availability and a sharp rise in interest rates in April and May. This condition was relieved in early May by Federal Reserve actions making additional reserves available through a reduction in reserve requirements and by open market operations. Subsequently, interest rates fell substantially and credit became more easily available.

In the late summer of 1953 the beginnings of a recession of output and employment occurred. This decline continued and accelerated during the fourth quarter of the year. In subsequent months the decline continued, particularly in durable manufacturing output and employment. The largest declines in the gross national product components were in Federal Government purchases and in private investment spending, most of the decline in the latter being in inventory accumulation.

Detailed analysis of the behavior of consumption and investment spending during 1953 and of the course of the recession reveals that the tight money condition of early 1953 had no marked effect on economic activity. Changes among major categories of investment spending appear to have been essentially unrelated to monetary-credit conditions, and a similar conclusion is indicated by evidence regarding consumer spending for credit-financed durable goods purchases. Installment credit did indeed temporarily slacken from previous levels but there is no conclusive evidence that the tight credit situation of early 1953 significantly affected consumer purchases of automobiles and other durable goods.

The major conclusion reached by this study is that Federal Reserve actions were not responsible for the downward movement of output and employment that occurred in late 1953. The tight money episode of 1953 produced substantial temporary changes in market interest rates and in the expectations of those concerned with the money market but do not seem to have had important effects on output and employment.

Microfilm \$4.15; Xerox \$14.00. 321 pages.

## ECONOMICS, HISTORY

## ENTREPRENEURSHIP IN MADRAS STATE, INDIA

(L. C. Card No. Mic 58-3212)

James J. Berna, S. J., Ph.D.  
Columbia University, 1958

This dissertation is a study of a group of industrial entrepreneurs in Madras State in South India: their economic and social background, the ways in which they have made the transition to industry from previous activities, and the problems they have encountered in establishing and developing their enterprises. An attempt is also made to evaluate entrepreneurs' performance in the light of the needs of an under-developed country attempting to industrialize rapidly. The study is based on original research carried out in India by the writer from January to September, 1957.

The study is confined to medium-scale manufacturing enterprises (employing between fifty and two hundred and fifty persons) in the light engineering industry. Fifty-two firms are included, or eighty-six per cent of all medium-scale engineering-manufacturing enterprises in the State. Forty-one are manufacturers of such producers' goods as agricultural processing machinery, power-driven pumps, structural shapes, textile machinery and electrical products. The remaining eleven produce consumer goods including household utensils, radios, fountain pens, buttons, automobile accessories and bicycles.

Chapter I discusses entrepreneurship in the setting of conditions prevailing in under-developed countries and develops criteria for evaluating entrepreneurial performance. Chapter II outlines the main features of the economic environment in which the entrepreneurs under study are operating. Chapter III presents findings on the background of entrepreneurs, the ways in which they have made the transition to industry, and problems encountered in getting established. Chapter IV discusses operational problems of entrepreneurs. Chapter V analyzes their record with respect to growth of enterprises and technological improvement. Chapter VI presents data on entrepreneurs' mobility and discusses the implications for a developing economy. The final chapter ventures some recommendations for future policy toward small and medium-scale industry in India.

A major finding concerns the extremely varied character of entrepreneurs' background. Contrary to widespread opinion in India, only a minority (28.8%) were found to be merchants. The second largest group (23%) are graduate engineers. Other important occupational groups represented are rural artisans, former factory workmen, cultivators and entrepreneurs in other industries. Entrepreneurs have been drawn from ten different Social Communities or castes. The findings indicate greater freedom of entry into industry than is generally supposed to exist in a less developed region of a country where caste and traditional occupation are important in determining economic status.

As a group, entrepreneurs were found to be interested in the growth of their enterprises and willing to reinvest earnings to that end. Forty-four firms began as small units, many of them as very small repair and odd-job shops. Growth has been achieved in the face of formid-

able obstacles, chief among which have been acute shortage of raw materials and capital, and constant and serious labor trouble.

Entrepreneurs' achievement with respect to technological improvement of their firms is less impressive. There is evidence, however, of growing interest in improving production methods and quality of output.

Many entrepreneurs have been active in diversifying production and shifting into new lines of production in response to changing conditions. In the absence of detailed data on costs it was not possible to decide whether greater specialization is preferable from the viewpoint of the economy as a whole.

As a group, the entrepreneurs studied were found to be far removed from the picture often presented as typical of the medium-scale industrialist in India--namely, the ex-merchant of very short time-horizon, interested only in fast turnover and quick profits, completely unconcerned with technology, and unwilling to invest more than a bare minimum in fixed capital.

Microfilm \$4.95; Xerox \$16.80. 387 pages.

THE COURSE OF COMPANY AND LOCAL  
INDEPENDENT UNIONS

(L. C. Card No. Mic 58-3251)

Leo Troy, Ph.D.  
Columbia University, 1958

It is the thesis of this study that when government affords employees an opportunity to select representatives for collective bargaining free of employer or union interference, many will choose representation by local independent unions. Before employees were protected in their choice of representatives, employers frequently chose labor organizations for them. These organizations became known as company unions and what the National Labor Relations Board defined as company dominated or assisted unions.

Company unions were first established in this country in 1898, but did not become widespread until the end of World War I. By 1935, company unions rivalled national unions in employee representation.

Owing largely to early and continuous government intervention, the history of national, company and local independent union organization on the railroads differed from other industries. Employees' right to self-organization was first guaranteed by the Railway Labor Act of 1926. But under the Amended Act of 1934, government protection of the right to organize on the railways went further than in other industries. It virtually prescribed the national union form of employee organization.

Under the Wagner Act company dominated or assisted unions were wiped out. This Act and its successor, the Taft-Hartley Act, as well as the National Labor Relations Board and the courts regard local independent unions as legal labor organizations capable of representing employees in collective bargaining.

The number of local independent unions covered in this study increased from 76 in 1939 to 385 in 1956. Total membership of these unions rose from less than 200 thousand in 1939 to more than 700 thousand in 1956.

Since the data covered less than 400 of a possible total of 3,000 local independent unions in 1956, the actual total membership of these unions must be much greater. Most independent membership is found in metals manufacturing, chemicals and public utilities. They are absent from industries with long histories of national union organization, construction, mining, apparel manufacturing and printing. Geographically, local independent membership was concentrated in those areas where national union membership was also centered. Where national unionism was absent or weak, as in the southern textile industries so were local independent unions.

Under the impact of increased government regulation of wages and prices during the Second World War, numerous local independent unions formed a geographic federation of labor, the Confederated Unions of America. After the war, it declined. When the Korean War broke out, it did not revive materially, one reason being the formation of another territorial federation of local independent unions, the National Independent Union Council. While both are similar to the AFL-CIO in being territorial labor associations, they differ from the major federation because neither can "validate" the claim of affiliated unions to an "exclusive jurisdiction" within one occupation or industry. Local independent unions have also formed occupational and industrial federations, the Engineers and Scientists of America and the Alliance of Independent Telephone Unions. While these organizations may be fore-runners to national unions neither is as yet.

Local independent unions challenge the basic principle of national unionism, elimination of all competition in the labor market subject to the national's "exclusive jurisdiction." While local independent unions remain unfiliated for many reasons, government protection of the right to organize from interference by either employers or unions enable them to keep this status. Available evidence, statistical and otherwise, supports the conclusion that local independent unions are a viable alternative to national unions.

Microfilm \$3.15; Xerox \$10.80. 243 pages.

## ECONOMICS, THEORY

### DYNAMIC LINEAR PROGRAMMING OF CONSERVATION ALTERNATIVES, INCLUDING HOUSEHOLD CONSUMPTION

(L. C. Card No. Mic 58-3019)

Wesley George Smith, Ph.D.  
Iowa State College, 1958

Supervisor: Earl O. Heady

This study was designed to develop a dynamic linear programming model and apply it in determining optimum five-year farm plans for two farms in the Ida-Monona soil area of western Iowa under alternative conservation situations. In all plans, household consumption is considered before farm production. On both farms, soil types are combined into two land productivity classes: Land A--a low productivity class; Land B--a high productivity class. Average management is assumed. Only one price level is used.

Optimum five-year plans were computed for the following situations; Situation I: 160-acre farm without crop fertilization and without terracing and contouring; Situation II: 160-acre farm with crop fertilization but without terracing and contouring; Situation III: 160-acre farm with crop fertilization and with contouring and terracing; Situation IV: 280-acre farm similar to Situation I; Situation V: 280-acre farm similar to Situation III.

Two dynamic linear programming models are developed. Each model permits the simultaneous programming of  $t$  years of restrictions and activities.

Cropping activities considered include all possible combinations and rotations of corn, oats and hay for a five-year period within certain limits.

In the plans for the 160-acre farm, Land A is used mostly for hay production and Land B for corn production. In all situations, hogs are more profitable than cattle. Cattle are only produced to utilize remaining resources after hog and crop production. Net returns were highest when fertilizer and contouring and terracing were included.

In the plans for the 280-acre farm, only hogs were produced. Hogs were more profitable than crop production on the majority of Land A, and most of Land A was left in disposal over the five-year period. Net returns were highest on the 280-acre farm when crops were fertilized and the land was terraced and contoured. On both sizes of farms, household consumption did not restrict the adoption of terracing and contouring.

In each plan, the cropping system in any one year depends upon livestock feed requirements and crop production over the five-year period. The plan specified for each year is the one which will result in maximum profits for the five-year period, after household consumption has been considered. The plans presented are, therefore, optimum five-year farm plans rather than optimum farm and household consumption plans.

Microfilm \$2.10; Xerox \$7.40. 157 pages.

## EDUCATION

### EDUCATION, GENERAL

#### ELEMENTARY AND JUNIOR HIGH SCHOOL VOICE TRAINING, VISUAL ANALYSIS, AND AESTHETICS OF LISTENING: AN ANALYSIS OF THE LITERATURE AND AN APPLICATION IN A SPECIFIC AREA

(L. C. Card No. Mic 58-2804)

Lee Morrett Beall, Ed.D.  
The American University, 1958

#### I. STATEMENT OF THE PROBLEM

It is the purpose of this study (1) to investigate and evaluate the methods of music education in the three major areas: i.e., the areas of voice training, visual analysis, and aesthetics of listening, and (2) to show which methods are recommended for use in specific school systems and if there are any special requirements for certification.

#### II. PROCEDURE

The first requirement in an investigation of this type is to find out which methods are being used in the three problem areas. This was accomplished by an analysis of the literature concerning the problem areas. A succinct presentation of methods and, in some cases, materials is stated.

In order to find out which methods are recommended for use in the specific school systems, a number of supervisors of music were interviewed. Moreover, these methods are compared to those recommended as a result of the analysis of the literature.

#### III. RESULTS

At the end of an intensive and extensive review of the literature, this author has found many divergences of opinions as to methods, causes, and remedies of classroom difficulties in the problem areas. Perhaps this is due to the fact that the teacher is dealing with individuals rather than things, and different people are motivated and respond to different stimulæ. There was, however, one unifying characteristic: that every author employed good teaching techniques.

In interviewing music supervisors, this author found, as in the literature, a variance of opinion. In some cases the supervisor had no particular method, and the manner in which the problems were overcome was left to either the teacher or the music series which was used.

#### IV. CONCLUSIONS

Voice training--uncertain singers. In aiding the uncertain singer the prime concern is to get him to hear the tone he should produce and to hear the way he produces

it. The general feeling of the music supervisors was to make the student aware of tone.

Voice training--adolescent voices. In spite of the divergence of opinions in the literature, the music supervisors, without exception, stated that the boy should sing during the change of voice, being careful not to strain the voice. An understanding of the physical changes should be imparted to the student.

Visual analysis. The reading readiness program is basic, employing extensive use of the rote song. Note and melodic patterns play the most important role in music reading.

Aesthetics of listening. The listening program is most productive when the "directed listening" technique is used. Involved in this is the attention and interest of the students.

Preparation of music educators. There are no special competencies required in the problem areas for teachers of music in the systems under investigation. Some of the supervisors had informal requirements, however.

Microfilm \$2.90; Xerox \$10.00. 221 pages.

#### THE RELATIONSHIP OF CERTAIN SCHOOL FACTORS TO THE HOLDING POWER OF SELECTED IOWA SECONDARY SCHOOLS

(L. C. Card No. Mic 58-2965)

James E. Hayes, Ph.D.  
State University of Iowa, 1958

Chairman: Professor L. A. Van Dyke

Studies of the problem of early withdrawals from the secondary school show that holding power varies widely from region to region. In a given area, holding power varies from size to size and to some extent among schools of similar size. Several explanations of this have been advanced. Some writers claim a "tradition" of high school attendance is growing and that community variables determine the extent to which the schools absorb the school age population. Others indicate that the school is the important variable and that holding power varies with the suitability of the program to the groups served. It was the purpose of this study to consider typical high schools in Iowa to determine what, if any, relationship exists between holding power and the goodness of certain factors of the school.

The school variables considered were: program of study, guidance program, extra curricular activities program, physical plant, teacher morale, and student morale. In schools selected for investigation, field workers made visits of one to four days. During the visit each factor was rated on a scale developed for this study. The sections were modeled after the like sections in Evaluative Criteria as developed by the Cooperative Study of Secondary

School Standards. Two morale sections were constructed solely for this study taking items from morale scales used in other studies.

A stratified random sample was drawn of Iowa schools utilizing the Iowa Tests of Educational Development in the years 1950, 1951, and 1952. Thirty-two schools, or five per cent, enrolling up to ninety-nine students; seventeen, or nine per cent, enrolling 100 to 249 students; and nine schools, or twenty-five per cent, enrolling over 500 students, were included in the sample. A holding power ratio was calculated by comparing total enrollments of the ninth grades to the number that had enrolled but at some point dropped out of school before completing the secondary program. Transfer students, both to and from the schools, were eliminated from the calculation.

Data were subjected to a double analysis procedure. First, zero-order correlations were computed among the holding power ratios for boys, for girls, and for total in each size group and the various sections of the observation of school factors. Secondly, null hypotheses were written to state no difference between ratings received by schools high in holding power and those low in holding power in each of the size groups. The "t" statistic was employed with the five per cent coefficient of risk.

Holding power percentages in the size groups were found to be: Group I schools, eighty-seven per cent; Group II schools, eighty-nine per cent; Group III schools, eighty-three per cent; and Group IV schools, seventy-six per cent.

No clear relationship of holding power to goodness of school factors is discernable except that extra curricular activities is probably related. While significant results were obtained with teacher morale, student morale, and physical plant, supporting data suggest the operation of chance.

Rates of holding power confirm other studies made for Iowa and suggest that the state is somewhat higher in this regard than is typical for the nation. At the same time, observations excerpted from the rating system employed by various accrediting agencies found most schools of the smaller size groups below the "good" standard. Since these schools had generally superior holding power, it would appear that a school may not be judged by its holding power--if indeed the school is the institution or force operating to influence holding power.

Microfilm \$2.20; Xerox \$7.80. 167 pages.

**A STUDY OF LEADERSHIP, GOAL  
SETTING, AND ACHIEVEMENT IN THE  
FIELD OF HEALTH IN JACKSON COUNTY,  
OREGON, 1917-1956**

(L. C. Card No. Mic 58-3678)

Dorothy Ann Huskey, Ed.D.  
University of Michigan, 1958

The primary purpose of this study was to determine the leaders and their characteristics, the way goals were set and achieved, and the obstacles encountered and overcome in seven community health projects considered to be successful in Jackson County, Oregon during the period from 1917 to 1956. A related interest of the study was to

discover whether the overall community leaders also were the leaders in these health projects. Projects were considered successful if they continued over a period of time, received the necessary financial support, and reached the goal set.

Descriptive accounts of the seven projects were reconstructed from newspaper clippings, minutes of meetings, reports, records, and other printed sources, and from interviews with individuals associated with these projects. An interview schedule was prepared to obtain specific information from selected individuals associated with the projects.

The study describes in some detail a series of events associated with the development of each of the projects.

The major results of the study show that:

Each of the projects was characterized by long range and more immediate goals which were set at the outset either by one or a few strong leaders and later accepted by those participating in the projects. The "democratic process" in which the participants help in the determination of the goals from the initial stages of the planning was followed only to a limited extent.

While the long range goals for the seven projects varied, the steps and the sequence followed in reaching the goals were similar. In each of the projects progress toward the goal was characterized by periods of success and failure.

While the leadership differed for the various projects, there was a relatively small group of individuals who appeared to form the nucleus for the several projects. The leadership varied with the nature of the problem and the phase or stage of development of the project.

Women had a major function in the health field in initiating projects and in securing community support and participation. Men were more active in projects and programs concerned primarily with raising money. Twenty-two of twenty-four overall leaders for the community were men. Eleven of the twenty-two men were active in a fund raising drive for a hospital construction project. Economically all of the leaders were in the upper fourth of the population.

Health projects, activities, and interests sponsored by national and state governmental and other agencies that were related to the seven projects had both a positive and a negative influence on the progress of these projects. In some instances the progress toward the goal was enhanced; in other instances, barriers were erected, impeding progress.

The nature of the goal and the source of funds were not important in determining whether a project would succeed; however, the source of funds was important in the determination of the people involved in the project and the organizational structure.

The internal group process was found to be the important factor in determining whether a project would succeed.

Microfilm \$4.70; Xerox \$15.80. 367 pages.

# THE RELATIONSHIP OF SELECTED INTERESTS OF MALE COLLEGE FRESHMEN TO THREE ACADEMIC LEVELS OF ACHIEVEMENT

(L. C. Card No. Mic 58-3695)

Leon Alvin Lande, Ed.D.  
University of Michigan, 1958

This study was basically concerned with the relationships of interests to different scholastic levels of attainment. The general hypothesis of the dissertation was: Do college freshmen, when divided into groups on the basis of scholastic achievement and chosen vocational fields, vary significantly in their interests?

The investigation was initiated for the specific purpose of analyzing and acquiring information concerning the following sub-hypotheses:

(1) Within each of nine selected vocational fields, are there any significant differences between the interests of a superior scholarship group and an average scholarship group?

(2) Within each of nine selected vocational fields, are there any significant differences between the interests of the superior scholarship group and an inferior scholarship group?

(3) Within each of nine selected vocational fields are there any significant differences between the interests of an average scholarship group and an inferior scholarship group?

The purpose of this study therefore was to determine which interests, if any, would differentiate between three academic levels of achievement, the Superior, the Average, and the Inferior students. The Superior group included students with a 3.0 point grade average or better, the Average group included students with a 2.0 and just below a 3.0 point grade average, and the Inferior group those with less than a 2.0 point grade average. The level of scholarship was determined by averaging freshman grades which were obtained from official records of the University. The nine vocational groups were chosen from the following departments, colleges, and schools of the University: Architecture and Design, Business Administration, Dentistry, Education, Engineering, Law, Medicine, Science, and the more general college of Literature, Science, and Arts. The interest inventory covered both academic and non-academic interests, such as Academic Subjects, Sports and Games, Cultural Activities, Scientific Hobbies, and Social Activities. A total of sixty-two items comprised the inventory.

The study was based on 3,528 student subjects who entered the University during the period of years 1953-1955. The data on interests were gathered either during group meetings in the freshman orientation periods or by distributing inventories during physical education classes. The students were instructed to check only those activities in which they had participated and enjoyed. The statistical treatment of the data involved the testing for significant differences between percentages at the 5 per cent level of confidence.

This study showed in its findings some definite relationships between interests and achievement. The Superior group as a whole and even when differentiated into nine vocational groups displayed a greater interest for

Academic Subjects than the other two groups (Average and Inferior) with whom they were compared. Moreover, they showed greater interest for the Cultural Activities and Scientific Hobbies that generally accompany and are identified with scholastic propensities. The Inferior Students showed more preferences for Sports and Games and for Social Activities of both organized and unorganized nature. In between, overlapping both groups in certain respects, were the Average students. As one would expect there were differences among the interests of the nine vocational fields. Within each of the nine vocational groups, it was sometimes possible to distinguish between the scholarship groups on the basis of their interests. In this respect there was much variation. Insofar as the results of this particular study would show, the hypothesis set up by the writer at the beginning of the study was therein partially fulfilled.

Microfilm \$3.85; Xerox \$13.00. 298 pages.

## ENROLLMENT CHARACTERISTICS AND TEACHER PREPARATION IN MICHIGAN SECONDARY SCHOOL MATHEMATICS

(L. C. Card No. Mic 58-3701)

Arvo Ephraim Lohela, Ph.D.  
University of Michigan, 1958

The purpose of this study is to determine the condition of mathematics in the accredited high schools of Michigan. The following analyses, comparisons, and investigations are presented: (1) the trend in enrollments in mathematics from 1925 to 1956, (2) the effect upon enrollments in mathematics of size of school, geographic location, and type of school, i.e., public or non-public, (3) characteristics of 1956 enrollments in mathematics with respect to grade level of students in various courses, boy-girl ratio, variety of offerings, and class sizes, (4) preparation and experience of teachers of secondary mathematics.

The following major conclusions are made:

1. The percent of in-school youth enrolled in mathematics in Michigan accredited secondary schools has decreased steadily since 1925 to a post war low in 1950, but has since experienced an upward trend signifying a positive response to the increased emphasis on mathematics education.

2. Enrollments in Michigan secondary school mathematics vary according to geographic areas.

3. Enrollments in Michigan secondary school mathematics do not vary directly with the size of schools.

4. Non-public secondary schools in Michigan tend to enroll a higher percentage of students in mathematics than do the public schools.

5. Larger schools in Michigan tend to have better prepared and more experienced mathematics teachers than smaller schools.

6. The traditional mathematical subjects of algebra and geometry are still the main fare in the mathematics curriculum of Michigan high schools. General mathematics is experiencing a constant growth in enrollments in public schools.

7. The traditional pattern of elementary algebra, plane geometry, advanced algebra, and solid geometry-trigonometry in grades nine, ten, eleven, and twelve, respectively, is not rigidly followed in Michigan.

8. Enrollments in high school mathematics in Michigan drop off rapidly in each succeeding grade. Girls' enrollments drop more sharply so that the overall ratio of boys to girls in mathematics courses is three to two.

The study leads to the following recommendations:

1. The "free-response" answers on the teacher questionnaires identified several criticisms regarding teacher preparation. A check-list questionnaire should be devised to obtain specific data on these critical areas:

- (a) college courses and/or experience in the practical applications of mathematics in many fields.
- (b) practice teaching experience under conditions more nearly related to average teaching situations.
- (c) college mathematics geared to the high school level so that beginning teachers will be familiar with appropriate content of secondary mathematics.
- (d) preparation of beginning teachers for dealing with a wide range of abilities and providing for the exceptional child.
- (e) instruction in motivation and classroom management.

2. A concerted program of studying the secondary mathematics curriculum in Michigan should be initiated. It is recommended that a multiple-track mathematics curriculum be considered to provide for greater percentages of high school youth.

3. The extremely high "mortality" of girls in high school mathematics should be examined. It is recommended that a new emphasis be given to the increased opportunities for mathematically trained girls in accounting, actuarial work, statistics, research, and teaching.

Microfilm \$2.00; Xerox \$5.80. 116 pages.

#### RELATIONSHIP OF HIGH SCHOOL VOCATIONAL AGRICULTURE AND SIZE OF HOME FARM TO ESTABLISHMENT OF GRADUATES IN FARMING

(L. C. Card No. Mic 58-3011)

Duane Melvin Nielsen, Ph.D.  
Iowa State College, 1958

Supervisor: Barton Morgan

This study of establishment in farming included 120 male graduates from 20 pairs of high schools located in the north central cash grain and the eastern livestock areas of Iowa. The 45 high schools in the two areas, which offered vocational agriculture during 11 of the 12 years in the period 1943 through 1954, were paired with 45 high schools that did not offer vocational agriculture during the same period. The 20 pairs of schools were randomly drawn from the 45 pairings.

All of the 120 men were living on farms at the time they were graduated from high school, and all were farm operators in 1955. Sixty of the 120 were vocational agriculture graduates, and 60 were nonvocational agriculture graduates. Sixty of the men were sons of landowners and 60 were sons of nonlandowners. Sixty were graduated during the 1943-1948 period and 60 were graduated during the 1949-1954 period. Forty of the graduates were living on home farms of 160 acres or less when graduated from high school, 40 on home farms of 161 through 319 acres in size, and 40 on home farms of 320 acres or more. Data for the study were obtained by personal on-farm interviews.

The graduates in the sample studied, who had three or more years of high school vocational agriculture, had larger mean scores, than graduates who had not received such training, for 28 of 32 measures of establishment in farming. An analysis of variance, multiple classification, was made for each of the nine more comprehensive measures of establishment. Significant differences were found, favoring the vocational agriculture graduates, for crop, livestock, and total gross products for the year 1955, and for production and management practices used on the farms operated by the graduates, 1943 through 1955.

Mean scores for 16 of the 32 measures of establishment increased with increases in the size of the home farms of the 120 graduates included in the sample. Four of the nine analyses of variance, multiple classification, yielded significant F values favoring the graduates from larger home farms. The four measures, with significant differences, were total acres farmed by the graduates in 1955, crop acres farmed by the graduates in 1955, and crop and total gross products from the farms of the graduates in 1955.

Subject to the conditions and limitations of this study, two conclusions appear warranted. First, farm operators who completed three or more years of high school vocational agriculture had higher crop, livestock, and total gross products from their farms, and had more extensively used improved production and management practices on their farms than high school graduates who did not receive such training. Second, farm operators who lived on larger home farms when graduated from high school operated larger farms with more crop acres, and had higher crop and total gross products from their farms, than high school graduates who lived on smaller home farms when graduated.

Microfilm \$2.00; Xerox \$6.40. 135 pages.

#### NON-SCHOLASTIC FACTORS ASSOCIATED WITH DROP-OUTS FROM PUBLIC SCHOOLS IN IOWA

(L. C. Card No. Mic 58-2977)

Paul E. Opstad, Ph.D.  
State University of Iowa, 1958

Chairman: Dr. L. A. Van Dyke

Certain non-scholastic factors were investigated to determine which ones actually differentiated students who

withdrew from students who graduated from public high schools in Iowa. The following factors were studied: absenteeism, participation in extra-curricular activities, residence with parents or guardians during high school, marital status of parents, occupational class of father, whether or not the mother worked, and the educational attainment of the parents.

The entering ninth grade classes of 1950, 1951, and 1952 were studied. A five per cent sample of the total estimated drop-out population for the total state was selected proportionately from 73 public high schools in Iowa. A total of 768 drop-outs was secured. Students who graduated were paired with the drop-outs with respect to school attended, year of entry into the ninth grade, and sex. Data on these subjects were secured from school records, from the teachers and administrators in the schools, from city directories, and from the files of the county A.S.C. offices. The ratio of male drop-outs to female drop-outs was 51 to 49.

Differences between drop-outs and persisters for each of the factors were tested for significance using the critical ratio technique, t-test, analysis of variance, (Type VI Design), and chi-square test, whichever was practical and feasible for the individual factor being tested. The results indicated that the difference between drop-outs and persisters was significant beyond the five per cent level for the factors of absenteeism, participation in extra-curricular activities, marital status of parents, educational attainment of the parents, and occupational class of the father. The differences for the other factors were not large enough to be of any practical importance. In all cases where a significant difference between drop-outs and persisters was found, the drop-outs were in the less favorable position. The drop-outs were absent a greater per cent of the time; they participated in fewer extra-curricular activities; a greater proportion of them came from broken homes; their parents did not progress as far through school; and the fathers of the drop-outs were engaged in occupations of lower prestige value. The differences were not significantly affected by sex or school size group from which the subjects came. In order to find the best combination of factors characteristic of drop-outs, multiple biserial correlations were obtained separately for boys and girls. Variables that did not produce significant weights in the regression equations were deleted with little shrinkage effect in the correlations obtained. A multiple biserial correlation between scores obtained on three variables and withdrawn was .65 for the girls. The variables included per cent of time absent, high school grade point average, and number of extra-curricular activity areas participated in. The correlation between scores obtained on five variables and withdrawal was .63 for the boys. These five variables were I.Q., composite score on the ninth grade Iowa Tests of Educational Development, high school grade point average, number of extra-curricular activity areas participated in, and educational attainment of parents. The regression equations were applied to a cross-validation sample resulting in point biserial correlations between the composite score on the variables and the withdrawal-persistence dichotomy of .63 for the girls and .53 for the boys. This indicates that the formulae were nearly as accurate in differentiating drop-outs from persisters in the cross-validation sample as they were in the original sample on which they were based. These formulae correctly identified 84 per cent of the male drop-outs, 80 per cent of the male persisters, 81 per cent of the female

drop-outs, and 79 per cent of the female persisters. The results indicate that drop-outs can be better differentiated from persisters when a combination of variables is employed. Microfilm \$3.05; Xerox \$10.40. 233 pages.

#### THE RELATIONSHIP BETWEEN LEADERSHIP PARTICIPATION IN COLLEGE AND AFTER COLLEGE

(L. C. Card No. Mic 58-2980)

Ronald W. Roskens, Ph.D.  
State University of Iowa, 1958

Co-Chairmen: Associate Professor A. N. Hieronymus  
Professor James B. Stroud

It was the purpose of this study to investigate relationships between measures of extra-curricular leadership and participation in college and leadership and participation in activities subsequent to graduation. The major hypothesis investigated was that this relationship would be positive and of sufficient magnitude to point to the values of college leadership programs in training future leaders.

The subjects of this investigation were 896 male graduates of the University of Iowa College of Liberal Arts during the years 1922 and 1923, 1932 and 1933, 1942 and 1943, and 1952 and 1953. This spacing at ten-year intervals permitted observation of leadership participation at various stages of life following graduation.

Data pertaining to college attendance were obtained on each of the following variables: curriculum (major), high school size, grade-point average, activity participation, and leadership performance. Data obtained concerning post-college activity included: income, occupational status, activity participation, and leadership performance.

The primary source of data relevant to under-graduate leadership and participation was the University yearbook. This information was substantiated or complemented by personnel records.

Separate score scales for college leadership and participation were developed which permitted the investigator to assign objective score values to each of the activities in which the subjects engaged. Judges evaluated the two lists of representative activities using the method of equal-appearing intervals. The resulting data were used in assigning the score values for each activity.

The first of these scales (leadership) involved leadership in its usual context, as it is required for the adequate fulfillment of certain roles. The second (participation) pertained to the expenditure of time and effort necessary in the fulfillment of roles.

Information regarding post-college leadership and participation was gathered by questionnaire. Again, separate scales for post-college leadership and participation were developed by judges in much the same manner as those for college leadership and participation.

Leadership subscores, which included relatively homogeneous types of activities, were developed at both levels. The college leadership subscores were: academic, social, and special interest. Post-college leadership subscores were: occupational and military, political and civic, fraternal and religious, and social and recreational.

Pearson product-moment correlation coefficients were used as measures of relationship. Coefficients were computed separately for the four samples identified in terms of graduation period.

The correlations obtained between the two major variables, college and post-college leadership, were: 1922-1923 = .37; 1932-1933 = .49; 1942-1943 = .63; 1952-1953 = .47. Thus, the major hypothesis of the study seems to be strongly supported by the findings.

The coefficients between college leadership subscores and the post-college leadership subscores ranged from .16 to .56, with the social and special interest subscores showing a somewhat higher relationship than academic subscores.

Extremely high correlations were obtained between measures of leadership and measures of participation at both the college and post-college levels, indicating that "leaders" are apparently quite active in other affairs as well.

Other findings were:

Coefficients involving grade-point average and college leadership increased in time from .16 for the 1922-1923 group to .59 for the 1952-1953 group.

College leadership shows a fairly low relationship to post-college occupational status of subjects and to income.

Post-college leadership bears very little relationship to grade-point average, occupational status of parents, or income. Microfilm \$2.20; Xerox \$7.80. 168 pages.

#### ACHIEVEMENT IN INTERMEDIATE ALGEBRA ASSOCIATED WITH CLASS SIZE AT THE UNIVERSITY OF WICHITA

(L. C. Card No. Mic 58-3018)

Harold Franklyn Simmons, Ph.D.  
Iowa State College, 1958

Supervisor: James E. Wert

This study of class size was conducted at the University of Wichita in the mathematics department. Students enrolled in intermediate algebra for the fall semester of 1956 formed the control group. These students were assigned to classes whose average size was 21.4 students and were taught by standard lecture-discussion methods. Students enrolled in intermediate algebra for the fall semester of 1957 formed the experimental group. These students were assigned to classes whose average size was 84.6 students. These students were taught by a formal lecture method with many illustrative examples worked out on the chalkboard. For the students in the experimental group, six hours for conference or help sessions were provided each week. The criterion of achievement chosen for this study was the mark in intermediate algebra.

A sample of 200 students was selected from the control group and from the experimental group. These students were so selected that 50 students graduated from each of four groups of high schools. These groups were: group I - Wichita High School-East, group II - Wichita High Schools other than East, group III - high schools located outside Wichita with an enrollment of over 250 students, and group

IV - high schools located outside Wichita whose enrollment was less than 250 students.

An analysis of covariance was used to test the effect of class size, high school group, and the interaction of class size and high school group on algebra achievement. This analysis was made holding constant prior achievement as measured by the high school grade average and student aptitude as measured by the total score on the American Council on Education Psychological Examination and the mathematics achievement score on the Co-operative General Culture Test. Five other measures of aptitude were tried and eliminated as not making a significant contribution to the analysis.

This covariance analysis revealed a highly significant difference in favor of the students in the small sized classes over students in the large lecture sections. The differences found among the four high school groups were not significant. Likewise, the interaction between class size and high school group was not statistically significant.

The attendance of the students in the experimental group at the conference sessions was studied to determine what effect, if any, these sessions had on achievement. The students who passed the course attended more conference sessions, but the difference was not statistically significant. The only conclusion relative to the conference sessions which can be made is that the students failed to take full advantage of them. Exactly one-half of the students failed to attend a single conference session and another 20 per cent attended five or fewer sessions.

Subject to the conditions and restrictions of this study, it can be concluded, that students in large lecture sections of intermediate algebra show less achievement than do similar students enrolled in small sized classes.

Microfilm \$2.00; Xerox \$3.80. 68 pages.

#### EDUCATION, ADMINISTRATION

##### CRITICAL REQUIREMENTS OF THE SECONDARY-SCHOOL PRINCIPALSHIP BASED UPON AN ANALYSIS OF CRITICAL INCIDENTS OBSERVED AND REPORTED BY SUPERINTENDENTS, PRINCIPALS, AND TEACHERS

(L. C. Card No. Mic 58-2750)

Ruth D. Bradford, Ed.D.  
University of Arkansas, 1958

Major Professor: R. K. Bent

#### I. THE PROBLEM

The purpose of this investigation was twofold: (1) to determine the critical requirements of the secondary-school principalship through an analysis of incidents observed and reported by superintendents, principals, and teachers; and (2) to ascertain the existence or nonexistence of a significant relationship between effectiveness or ineffectiveness of principalship behavior and each of the following: sex, age, years of experience, race,

previous position held, certain personality traits, and major areas of principalship responsibility.

## II. PROCEDURE

The research design employed in this study, the critical incident technique, is a systematic method of collecting descriptions of behavior of some specific subject, analyzing the data obtained, and formulating the final results. The principal aim of the technique is to produce a list of specific behaviors found in a significant number of instances that seem to reflect effectiveness or ineffectiveness in the job being considered.

## III. DATA COLLECTION AND FORMULATION OF REQUIREMENTS

The data consisted of (1) critical incidents and (2) certain characteristics of the principal. Critical incident questionnaire forms, designed to obtain objective descriptions of effective and ineffective behaviors of principals, were sent to 700 prospective respondents. Five hundred forty-two incidents were reported by 271 respondents.

Incidents were classified into five major areas which represented five different phases of the principal's job. Similar behaviors within the major areas were grouped, and statements were formulated to encompass common behaviors. By this process a total of 108 critical requirements associated with the high-school principalship were formulated.

## IV. STATISTICAL ANALYSIS

The chi-square test was used to determine the existence of relationship between certain paired variables. Twenty-five chi-square values were computed to test hypotheses of independence.

## V. FINDINGS

Analysis of the data collected resulted in 108 critical requirements grouped into five major areas and nineteen subareas of principalship responsibility. Arranged in descending order according to the number of behaviors covered the major areas are: Area IV, Relations with Students; Area I, Implementation of the Role of Democratic Leadership; Area II, Administration and Supervision of the Instructional Program; Area III, Relations with Staff; and Area V, Relations with Parents and the Community.

More effective than ineffective behaviors were reported for the phases of the principal's job dealing with administration and supervision of instruction, staff relations, and community relations. Conversely, more ineffective than effective behaviors were reported in regard to relations with pupils and leadership responsibility.

It was found that the principal was most effective in instructional administration and supervision and least effective in his relations with pupils, especially in the area of discipline.

Age, previous position held, and training were found to be related to effectiveness or ineffectiveness of the principal; while sex, experience, and racial identity were unrelated to this factor. Certain paired personality traits are related to effectiveness or ineffectiveness of the principal; major areas of responsibility are also related to this factor.

## VI. RECOMMENDATIONS

Requirements derived from a higher percentage of ineffective than effective behaviors should be given special consideration in programs of preparation.

Requirements formulated in this study should form the basis of a self-rating scale to be used by principals as a self-improvement tool.

The following should be included among criteria for selecting candidates for the high-school principalship: (1) at least the master's degree, (2) teaching experience at the secondary level, and (3) a maximum age of forty years.

Additional studies of on-the-job performance of principals, involving judgments of students, parents and non-instructional staff, should be conducted.

Microfilm \$2.15; Xerox \$7.60. 163 pages.

## AN ANALYSIS OF THE RELATIONSHIP OF SIZE OF ARKANSAS HIGH SCHOOLS TO ACADEMIC SUCCESS OF GRADUATES IN THE FIRST YEAR AT THE UNIVERSITY OF ARKANSAS

(L. C. Card No. Mic 58-2752)

Elbert Lee Dickerson, Ed.D.  
University of Arkansas, 1958

Major Professor: R. M. Roelfs

## THE PROBLEM

Arkansas reduced the number of school districts considerably in 1949 by eliminating all administrative units with an enumeration of less than 350 students. Notwithstanding, many high schools remain which are much smaller than most authorities recommend.

This investigation was made to determine if a significant relationship existed between academic success in the first year at the University of Arkansas and size of the preparatory high school with mental ability as measured by the American Council on Education Psychological Test held constant.

Sub-purposes of the study were to determine if significant differences in reading comprehension and mental ability existed by (1) size of preparatory high school, (2) sex, and (3) college in which students were enrolled.

## THE PROCEDURES

The sample was composed of all freshmen students at the University of Arkansas in 1956-57 subject to two limitations: (1) the student must have been graduated from a public high school in Arkansas during the school year 1955-56, and (2) the student must have participated in the state-wide college entrance testing program in which the A.C.E. test was given. There were 617 students meeting these qualifications.

The preparatory high schools were stratified into four

groups according to average daily attendance in grades 10-12:

Very small	50 or less
Small	51 - 125
Medium	126 - 300
Large	over 300

Students were separated by college enrollment and sex so that students pursuing substantially the same program of studies were compared.

Three statistical techniques were employed in this investigation. Chi square was used to test agreement between those who remained in college as contrasted to those who withdrew. Analysis of variance was employed to test the significance of difference of means on A.C.E. and reading tests. The analysis of covariance served to analyze the difference in grade-point means after obviating the factor of mental ability.

A review of literature indicated that the recommended minimum size of high school should be approximately 250-300 students in grades 10-12.

### THE FINDINGS

1. Only 6.2 per cent of the white high schools of Arkansas contain over 300 students in average daily attendance in grades 10-12 during 1955-56. 2. The rate of withdrawal from the University of Arkansas was significantly greater for the students coming from the small high schools when compared with that of the large high schools. 3. The students from the large high schools had a significantly higher mean in both reading comprehension and A.C.E. than those students from the medium, small, and very small high schools. 4. Females were significantly superior to male students in reading ability. 5. Female students earned significantly higher marks than males at the University of Arkansas. 6. The analysis of covariance test of grade-point averages with mental ability held constant produced only one significant F value of nine tests.

### THE CONCLUSIONS

1. Students from the small high schools of Arkansas tend to withdraw from the University of Arkansas at a higher rate than those from the large high schools. 2. Students coming to the University of Arkansas from the large public preparatory high schools of the state have significantly greater scholastic ability than those from the small schools. 3. When mental ability is held constant, the size of the preparatory high school seems to have very little, if any influence on the academic achievement of the student once he reaches college.

Microfilm \$2.00; Xerox \$5.20. 102 pages.

### A STUDY OF ADMINISTRATIVE ORGANIZATION AND ADMINISTRATIVE PRACTICES IN WASHINGTON PUBLIC JUNIOR COLLEGES

(L. C. Card No. Mic 58-3049)

Robert H. Wilson, Ed.D.  
State College of Washington, 1958

The purposes of this study were to obtain information describing the administrative organization and practices of Washington public junior colleges, and to appraise the administrative organization and practices of Washington public junior colleges by applying criteria established by a panel of experts.

Data about present administrative organization and administrative practice were obtained by means of (1) a survey of junior college catalogs and faculty policy manuals, (2) personal interviews, and (3) questionnaires.

Six questionnaires were used in collecting data. Five were sent to selected administrative positions, and the sixth to a panel of experts. Fifty questionnaires were mailed to administrative officers of Washington public junior colleges. Twenty-four questionnaires were mailed to the panel of experts. All questionnaires, or 100 per cent, were returned.

Appraisal was made of present junior college administrative organization and administrative practices on the basis of criteria established by the panel of experts. Recommendations based on this appraisal were made.

The following are administrative positions in the administrative organization of Washington public junior colleges which were selected for study: (1) Superintendent of Schools, (2) Administrative Head, (3) Registrar-Bursar, (4) Director of Student Affairs, and (5) Director of Evening Division.

Superintendent of Schools.--Washington public junior colleges are part of the common school system. Responsibility for operation of the junior college is delegated to the superintendent by the school board. The majority of administrative practices of this position were rated desirable. Rated less than desirable was the superintendent not delegating selection of junior college personnel to the administrative head.

Administrative Head.--This position is delegated responsibility by the superintendent for operation of the junior college. The majority of administrative practices for this position were rated desirable. Those practices rated less than desirable were not delegating routine business, and not sharing, where possible, administrative functions with other staff members.

Registrar-Bursar.--This position is delegated responsibility by the administrative head for records, registration, admissions, statistics and reports, service functions, bursar functions, and veterans' affairs. The majority of these practices were rated desirable. Those practices rated less than desirable were: (1) functions which could be, but were not, delegated to clerical personnel, and (2) practices which should have been shared with the staff.

Director of Student Affairs.--This position is delegated responsibility by the administrative head for guidance, testing, and student affairs. The majority of practices were rated desirable. Those practices rated less than desirable were: (1) not sharing the counseling duties with faculty counselors, and (2) not sharing the student affair's duties with students and faculty.

Director of the Evening School.--This position is delegated responsibility by the administrative head for the evening school program. The majority of practices for this position were rated desirable. The practice rated less than desirable was the performance of clerical duties by the director.

Summary.--Using the ratings of the panel members as criteria, it is apparent that the majority of administrative practices of administrative officers in Washington public junior colleges are desirable practices. Those practices rated less than desirable concern the administrative officers doing routine or clerical work or failing to share responsibility with staff or students.

Microfilm \$2.60; Xerox \$9.00. 198 pages.

## EDUCATION, ADULT

### THE IMPACT OF EDUCATIONAL PROGRAMS ON THE ACCULTURATION OF ADULT JEWISH IMMIGRANTS IN METROPOLITAN DETROIT (1949-1955)

(L. C. Card No. Mic 58-3633)

Ezri Atzmon, Ph.D.  
University of Michigan, 1958

This is a study of the effect of the educational programs offered to adult Jewish immigrants in Detroit on their acculturation in the following five areas: command of the English language, citizenship, economic status, social relations, and consumption and acceptance of American culture. It is an investigation of the relationship between the acculturation of immigrants and such variables as years of residence in the United States, cultural background, sex, age-level, marital status, educational background, parental economic background, type of immigrant, and length of exposure to the educational programs.

Fifty adult Jewish immigrants between the ages 20 and 60 who have resided in this country for a minimum of one year and a maximum of six years were the subjects of this study. They were of 21 different cultural backgrounds and were exposed at some time to the educational programs for immigrants offered by Detroit agencies. Thirty-one nationally known authorities on immigrant education, social workers, and teachers were consulted as were materials from 15 libraries. Classes in session were also visited, and documentary and field studies of the Detroit and New York City adult education systems were made. Lastly, 50 immigrants were subjected to an intensive interview and administered a standard questionnaire which was appraised by a panel of experts in New York City.

It was found that:

1. Six per cent of the subjects revealed "outstanding", 72 per cent "good", 22 per cent "satisfactory", and none "poor" acculturation.
2. In English 94 per cent scored between "outstanding" and "satisfactory", the rest scoring "poor". In citizenship all the subjects scored between "outstanding" and "satisfactory", with an average of 85.58 per cent. In economic

adjustment 82 per cent scored between "outstanding" and "satisfactory", while 18 per cent scored "poor". In social relations 88 per cent scored between "outstanding" and "satisfactory", the rest scoring "poor". In consumption and acceptance of American culture all the subjects scored between "good" and "satisfactory".

3. An analysis of some variables shows that there is a marked relationship between acculturation and years of residence in the United States. Only those who had four years or more of residence achieved "outstanding" acculturation, and out of the 36 subjects who achieved "good" acculturation 32 also had a residence of four years or more. Little relationship has been found between acculturation and cultural background, although the highest acculturation was reached by subjects of Polish-Israeli, Austrian, and German-Israeli background only. No clear relation has been found between acculturation and sex. Age-level has been found to have a bearing on acculturation. The younger subjects showed a higher degree of cultural integration. Marital status shows little relation to acculturation, although the findings slightly favor the married people. A marked relationship was observed between acculturation and educational background. The "outstanding" score was made by subjects of college or high school education only. Parental economic background relates positively to acculturation. The "outstanding" group consisted of only those whose parents belonged to the upper or middle class. "Displaced persons" acculturate equally well as other types of immigrants. Length of exposure to educational programs for immigrants relates positively to acculturation, since those who attended the programs for the greatest number of terms achieved the highest degree of acculturation.

Microfilm \$3.40; Xerox \$11.60. 264 pages.

### IMPLICATIONS OF CHARACTERISTICS AND ATTITUDES OF FARM AND VILLAGE WOMEN FOR HOME ECONOMICS EXTENSION PROGRAMS

(L. C. Card No. Mic 58-3004)

Roger Lee Lawrence, Ph.D.  
Iowa State College, 1958

Supervisor: Barton Morgan

The Cooperative Extension Service in Agriculture and Home Economics of Iowa State College is charged with the responsibility of conducting educational programs in agriculture, home economics and related areas with the people of Iowa. Very little work is being done with women who live in the numerous village centers in the state.

The purpose of the study was to examine characteristics and attitudes of farm and village women and to study the implications of these characteristics and attitudes on the administration of a home economics extension program. The data for the study were gathered from 147 women who are heads of households who reside on farms and 111 women who are heads of households who live in the village center in the Collins, Iowa community.

The village women were found to be older than the farm women, more of them worked outside the home for pay,

they placed greater importance upon a college education for their children, and they had more of a problem with money management than did the farm women. The village women made less use of radio as a source of homemaking information. The village women visited more about homemaking matters with their neighbors and friends in the local community, while the farm women visited more with relatives as well as neighbors and friends both within and outside of the local community. The village women did not participate in formal organizations as much as did the farm women, but the village women rated higher on semi-formal participation in the local community and in informal participation.

The most striking differences between the two groups of women were in their knowledge and use of the extension service. More of the farm women recognized the extension service as a source of information; they knew more about the service, had received more help from it, and had had more kinds of contacts with the service than had the village women.

No differences were demonstrated between the two groups in their educational level, the degree of importance placed on 10 values and 19 homemaking problems, their current use of recommended practices, the procedure used in adopting a new practice, their use of television as a source of homemaking information, their reaction to the community, and most of their ideas regarding the kinds of help desired from the extension service.

The general conclusion is reached that the same home economics extension program could be conducted with the village and the farm women, but in order to expect comparable results from the two groups, an educational program regarding the extension service, the services available, and ways and means of using the service should be conducted with the village women prior to launching a full scale program with the village group.

Microfilm \$2.75; Xerox \$9.60. 210 pages.

## EDUCATION, HISTORY

### THE JEWISH EDUCATIONAL SYSTEM IN PALESTINE DURING THE TIME OF JESUS

(L. C. Card No. Mic 58-2806)

James Walter Carpenter, Ed.D.  
The American University, 1958

#### THE PROBLEM

Western civilization is indebted to the Jews for its basic concepts of monotheism, morality and ethics, and for the Old Testament, the basis for much of the literature of the Western world. Christianity is also indebted to Judaism since much of its teachings, techniques and educational concepts have their roots deep in Hebrew origins.

Jewish education in Palestine during the time of Jesus is of special interest to both Western and Christian educators. The Judaism of this period, which culminated at the destruction of Jerusalem, stands at the crossroads of change. It represents the beginning of a new emphasis upon schools, with a consequent decline of the family as the primary educational institution.

This important period of Jewish education has been grossly neglected. Most Jewish historians have treated Jewish education in the broad sweep of such eras as the Second Commonwealth or the Tannaim. No doubt the paucity of dependable primary material has been responsible for this neglect.

Philo is not too reliable and Josephus has little to say on this subject. The Talmud is the main source of information about Jewish education, but it was not redacted until long after the time of Jesus. Little information is forthcoming from apocryphal literature. Even the New Testament takes for granted the educational institutions of Judaism without discussing them.

#### METHODS AND PROCEDURES

This study has attempted to isolate the pedagogical situation of Jewish education in Palestine during the time of Jesus. Since Jewish education was more a development than a series of abrupt changes, this work has sought to clarify the evolution of Jewish education which climaxed at the destruction of Jerusalem in 70 A.D. Every effort has been made to determine dates of changes in educational customs by determining dates of edicts and of those leaders who contributed to them. Special attention has been given to the first generation of the Tannaim, which corresponds to the lifetime of Jesus. To the author's knowledge, every major work on Jewish education has been consulted. Where references have been made to primary sources, these have been used.

#### SUMMARY AND FINDINGS

The family continued to be the main educational institution, much as in Old Testament days. However, it was beginning to give way to the increasing importance of schools, even on the elementary level. The educational ladder was now complete, especially in the Jerusalem area. Johannon ben Zakkai completed the three level curriculum. These were Mikra of the elementary Bet Ha-Sefer, Mishna of the secondary Bet ha-Midrash, and Talmud of the academies.

The synagogue was well established in every community. Most synagogues had a Bet ha-Midrash, and many had added the Bet ha-Sefer. This growth resulted from the success of the many private schools, and as an effort to combat Hellenism.

The Torah was the one text of Jewish education. Secular learning, if present, was secondary. A new order of teaching scribes had arisen to dominate every phase of Jewish education. They were the guardians and interpreters of Scripture, and were responsible for the growing mass of oral tradition.

The Jews believed that Torah could be learned by being obeyed. Since their main pedagogical method was oral instruction, they placed great emphasis upon rote memory supported by stern discipline, various mnemonic devices and constant review.

An understanding of Jewish education in Palestine during the time of Jesus is of interest to all who would see clearly the educational framework into which Christianity was born. Perhaps such a study would also throw light upon the teaching ministry of Jesus. It would be stimulating to compare His methods and approach to teaching situations with other teachers of His day.

Microfilm \$3.55; Xerox \$12.20. 276 pages.

## EDUCATION, PHYSICAL

A STUDY OF TWO METHODS OF  
TEACHING BOWLING TO COLLEGE WOMEN  
OF HIGH AND LOW MOTOR ABILITY

(L. C. Card No. Mic 58-2962)

Mary Frances Hall, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Margaret G. Fox

The purpose of this study was to determine the results of the whole and part methods of teaching beginning bowling to college women of high and low motor ability.

High motor ability subjects were those students whose scores fell in the upper quartile (T-score of 56 or above) on the Scott Motor Ability Test. Low motor ability subjects were those students whose scores fell in the lower quartile (T-score of 44 or below) on the same test.

The whole method was defined as the teaching of the entire coordinated skill with no practice on the separate parts. The part method was defined as the division of the whole skill into its component parts, then learning and practicing the parts before combining them into a coordinated whole.

Beginning bowlers were those who had bowled four games or less and who had received no previous instruction in bowling.

The subjects used in this study were women students enrolled in the beginning bowling classes at the State University of Iowa during the 1957-58 academic year. A total of 40 subjects was used. There were five in the upper group whole method and four in the upper group part method for a total of nine in the high motor ability group. There were nineteen in the lower group whole method and twelve in the lower group part method for a total of 21 in the low motor ability group.

All groups received eight weeks of instruction, and the classes met twice a week for 80 minute periods. All groups were taught the four step approach, straight ball delivery, and spot aiming. The same instructor taught all classes.

Because of the probable lack of reliability of a single game score as a measure of success in bowling, cumulative averages of the groups were used as the criterion value for measuring bowling success. A total of thirteen games was used for the upper groups and a total of sixteen games for the lower groups. During lessons one and two the subjects bowled at full set-ups only.

Learning curves were plotted for each group and the "t" test for the significance of the difference between means was applied to the cumulative averages of both groups. At no point was there a significant difference between the cumulative averages of the part method and the whole method subjects in the upper group. Likewise, at no point was there a significant difference between the cumulative averages of the part and whole method subjects in the lower group.

Based on the statistical data obtained, the following may be concluded about this study:

There was no statistically significant difference between the cumulative averages of beginning bowlers of high motor ability taught by the whole method and those taught by the part method. Also, there was no statistically

significant difference between the cumulative averages of beginning bowlers of low motor ability taught by the whole method and those taught by the part method. Therefore, ability to learn bowling by bowling by a particular method was not affected by level of motor ability. It should be pointed out that this experiment was conducted with a small sample and the conclusions might not be valid for a larger group. Microfilm \$2.00; Xerox \$3.80. 66 pages.

## EDUCATION, PSYCHOLOGY

A COMPARISON OF A SYNTHETIC WITH  
AN ANALYTIC METHOD OF TEACHING  
PHONICS IN FIRST GRADE

(L. C. Card No. Mic 58-3782)

David Eli Bear, Ed.D.  
Washington University, 1958

Chairman: Stephen C. Gribble

This study was a comparison of two methods of teaching phonics in the first grade and of the effects of the methods upon silent reading abilities as measured by standardized tests. The phonic methods compared were the synthetic and the analytic.

The synthetic method begins with teaching the sounds of letters and later the blending of these sounds into larger units. This method makes much use of drill on isolated sounds in a special period provided for the purpose. When the analytic method is to be used, pupils are first taught to recognize a small group of words. They then learn phonic generalizations by comparing known words for likenesses in form and sound. In this method attention is directed toward whole words in meaningful context.

The experiment began in September, 1956 and continued throughout the school year. Seven first grade classes in the public schools of Alton, Illinois representing the experimental group, used the synthetic method. Another seven first grade classes constituted the control group and used the analytic approach.

Both the experimental and control groups used the same basal reading series. The variable was the method of teaching phonics. The experimental group eliminated the basal reader phonics program and in its place used the primer Reading With Phonics published by the J. B. Lippincott Company. The control group followed the phonics program as outlined in the teacher's manual of the Row, Peterson Company basal reading series.

The groups were matched on the factors of chronological age, mental age, reading readiness, social status, and kindergarten training. There were no differences between the means of the two groups sufficient to reject the null hypothesis.

The groups were tested in January, 1957 with the Gates Primary Tests, Form 1. In May, 1957 the groups were tested with the Gates Primary Tests, Form II; the Metropolitan Achievement Tests, Primary I Battery; the Durrell Test for the Visual Discrimination and the Durrell Test for Hearing Sounds in Words.

The "t" test statistical technique was used to test the null hypothesis of no significant differences between the means of the two groups on the achievement tests. The 1% and 5% levels of confidence were used in rejecting the hypothesis.

The experimental and control groups were first compared on the performance of the total of pupils in each group. Following this the pupils were divided into three intelligence levels and the achievement test results compared. The first division included the pupils below 101 I. Q., the second, those between 101-120 I. Q., and third, those above 120 I. Q.

The results of the testing program for the total pupils in each group justifies the conclusion that the experimental or synthetic method produced higher reading achievement scores after one year of instruction than the control or analytic method. When the total groups were separated into three divisions, each on the basis of intelligence, the differences between the means were significant for the 101-120 I. Q. group, and for the group below 101 I. Q. in favor of the synthetic method. At the high-intelligence level the differences between the means were in favor of the synthetic method but only the Test for Hearing Sounds in Words rejected the null hypothesis.

Observable differences between the groups taught by the two methods were not found at the end of one semester of teaching.

The general conclusion is that synthetic phonics can successfully be used parallel to a basal reading program and serve as a valuable supplement in developing reading skills. Microfilm \$2.00; Xerox \$5.80. 118 pages.

#### THE EFFECT OF COUNSELING ON ACHIEVEMENT MOTIVATION

(L. C. Card No. Mic 58-2903)

Russell W. Burris, Ph.D.  
Indiana University, 1958

In order to assess the significance of *n* Achievement studies to the field of educational psychology, the following hypothesis was established for this study: Achievement motivation among individual college freshmen can be assessed by scores obtained on the *n* Achievement Test, and the effects of individual counseling based on this assessment can be noted in performance on the *n* Achievement Test and other behavioral measurements related to achievement motivation after such counseling.

Eight forty-minute counseling sessions were held for each of 22 experimental subjects. Each of 22 subjects in a first control group was seen an equal number of times. A second control group was not seen by the experimenter. These subjects were selected from 320 freshman students enrolled in the reading and study for self-improvement class at Indiana University, and each subject was matched with a subject in the other two groups by sex, age, class standing, ACE test scores, and scores on a *n* Achievement Test.

The objective of counseling for the experimental group was to increase each student's awareness of and understanding of his achievement goals, goal needs, means of accomplishing the goals, anticipations and emotional con-

comitants of the goals, pressures from other persons as associated with these goals, and internal and external obstacles to these goals. The same topics were covered in the sessions with the first control group; however, only questions were asked about the topics.

After the treatment period and a week prior to the end of the semester, a second form of the *n* Achievement Test was given. As measurements of achievement-related behavior scores on two tests which have been shown to have a positive relationship to *n* Achievement, scores on a standardized reading and comprehension test, final grades for the semester during which the study was made, and mid-term grades for the succeeding semester were obtained for all subjects.

A significant difference between scores on the first and second *n* Achievement Tests was noted only for the experimental group. An analysis of variance for treatment effects showed a significant difference for the amount of change in scores on these same two tests among the three groups. None of the scores on the tests used as corroborating measures of changes in achievement motivation showed a significant difference among the three groups. While an analysis of final grades failed to show a difference, an analysis of variance for the amount of change from the final grades to the mid-term grades of the succeeding semester did show a significant difference among the three groups. This difference was shown to be caused by a significant increase in grade average from the final to the mid-term grades for the experimental group, a decrease (not significant) in grade average for the first control group, and a significant decrease for the second control group.

It was concluded that the counseling based on an assessment of individual college freshmen's achievement motivation obtained from their scores on a *n* Achievement Test did cause an increase in their scores on a second *n* Achievement Test, and that the effects of this counseling were also noted in a significant increase in grade averages from the end of the semester in which the counseling occurred to the mid-term grade period of the succeeding semester. Microfilm \$2.00; Xerox \$5.00. 99 pages.

#### THE EFFECT OF SOCIAL RELATIONS ON THE BEGINNING TEACHER'S DISPOSITION TO SEEK ADVICE

(L. C. Card No. Mic 58-3649)

Marion Cranmore, Ph.D.  
University of Michigan, 1958

This study is designed to investigate the relationship between the "facilitativeness" attributed to a person and the disposition to ask him for help. For the purposes of the study, "facilitativeness" is defined as the resources attributed to a person, or his ability to help, minus the potential threat he may generate for the one who seeks help. The proposal is examined from the standpoint of the beginning elementary school teacher. His perceptions of the principal and other teachers are studied in relation to two sets of requirements of the classroom teacher's role. The requirements are defined as professional requirements (teaching methods, exceptional children, and classroom

management) and school system requirements (routines, special services, and curriculum).

Data were gathered by questionnaire from one hundred first-year elementary teachers in public schools. Each teacher's responses were rated and experimentally tested. The results showed that an attribution of potential threat reduces the disposition to ask help of a person who is perceived to have the ability to help.

Further hypotheses were formulated concerning: (1) the consequences for the beginning teacher of social relations in the elementary school, and (2) conditions affecting his perceptions of the two sets of requirements. The following were supported:

1. The beginning teacher has more need for help, and at the same time expects less help to be given him, in professional requirements than in school system requirements.
2. The beginning teacher sees his principal as more able to help in school system requirements than in professional requirements.
3. The beginning teacher perceives teachers at or near his grade level as more able to help him than teachers at other grade levels.
4. The beginning teacher who reports needing help in any requirements attributes more potential threat to the principal than to teachers.
5. The beginning teacher who reports needing help concerning teaching methods and exceptional children attributes more potential threat to the principal than the teacher who reports needing little help in respect to these.
6. The beginning teacher who reports needing help is more disposed to ask teachers at or near his grade level than to ask the principal concerning teaching methods, classroom management, and curriculum. He is disposed to ask the principal for help concerning special services. He is disposed to ask either the principal or teachers at or near his grade level for help concerning exceptional children and school routines.

The results showed the beginning teacher's disposition to ask principals and teachers for help to be modified by his perception of his status in the hierarchy, the potential threat which he associates with certain requirements, and the high resources which he attributes to teachers at or near his grade level.

Two general conclusions can be drawn from the study: (1) The beginning teacher is more disposed to ask help of the principal and of teachers when he attributes little potential threat to them. (2) The beginning teacher tends to turn to teachers at or near his grade level rather than to the principal for help when he both needs help and associates a high degree of potential threat with the act of seeking help. Microfilm \$2.40; Xerox \$8.40. 181 pages.

## THE HISTORY AND PRESENT STATUS OF SPECIAL EDUCATION PRACTICES AND FACILITIES IN MISSOURI

(Publication No. 24,365)

Adrian Jackson Durant, Jr., Ed.D.  
University of Missouri, 1957

Supervisor: William R. Carter

**STATEMENT OF THE PROBLEM:** The purpose of this study was to survey special education in Missouri; including a review of its background and development, as it now exists, and with regard to future planning.

**METHOD OF THE STUDY:** A careful definition of important terms was presented. Examination of the literature concerned with exceptional children provided background information and history of special education. The historical background of special education and its development to the present date was reviewed, including that of the Missouri School for the Blind and the Missouri School for the Deaf, and an outline of the growth of some local district programs of special education in the state. Related studies were reviewed, and administrative provisions and responsibilities on the federal, state, and local level discussed. The scope of special education in the state was reviewed, and recommendations for further studies were based on the educational needs of exceptional children as implied by the study. A listing of the Missouri laws applicable to special education was placed in the appendix as a ready reference.

**CONCLUSIONS:** Efforts devoted toward the education of exceptional children are not new, with the first special school established in the United States in 1848. Each state has the right and responsibility for the organization of its educational systems, and all states now make statutory provisions for the education of exceptional children. State financed programs of special education began in Missouri with the establishment of the schools for the blind and deaf in 1851, with provision for public school classes provided by law as early as 1919.

A Section of Special Education was established in the Division of Instruction, Missouri State Department of Education in 1946, and a Director of Special Education appointed in 1947. Legislation in 1948 and 1955 provided increased support to local school districts. In 1957 further legislation provided state aid for home teaching, reduced the number of exceptional children from ten to six for which instruction in special classes was required, directed a special census of handicapped children by the county superintendent of schools, provided for the establishment of area or county training centers for trainable mentally retarded children, and authorized the organization of special school districts for handicapped children.

According to recent estimates, 90,000 children, or 12 to 13 per cent of the school population in Missouri are exceptional. In Missouri, as in other states, an acute need is for special education in the rural areas. Sound administration is considered a most important factor in special education, with particular emphasis on the local level.

A major problem in special education is that of teacher demand and training. All of Missouri's state supported teacher training institutions offer courses in the field of special education or courses related to it. The workshop or conference approach proved to be an effective means of teacher education. In Missouri there are 590 teachers working in public school programs of special education, and during the 1955-1956 school year there was a total of 28,311 children enrolled as follows: blind and partially sighted, 125; deaf and hard of hearing, 211; mentally retarded and deficient, 10,688; orthopedically handicapped, 1,171; and speech defective, 16,116.

Other areas of special education receiving increasing attention and support in Missouri without the benefit of state laws and financial aid include programs for the emotionally disturbed and for the gifted.

Microfilm \$5.55; Xerox \$19.60. 433 pages. Mic 58-5074

AN EXPLORATION OF CERTAIN  
PSYCHOLOGICAL COMPONENTS RELATED  
TO THE SELECTION OR REJECTION  
OF ELEMENTARY TEACHING BY  
COLLEGE WOMEN

(L. C. Card No. Mic 58-3659)

Meryl Edwin Englander, Ph.D.  
University of Michigan, 1958

This study examined the proposition that individuals select a vocation which they perceive as a means of implementing their self concept.

A preliminary investigation had identified four factors which seemed to be important aspects of women's vocational plans. These factors were (1) the individual's personal characteristics, (2) the features of particular occupations, (3) the desire for opportunities for achievement or affiliation, and (4) the approval of one's family or friends. Each of these factors suggested a hypothesis which could be tested within the framework of self-psychology.

The subjects for this study were 126 white college-age women in their junior year of college at Sacramento State College and College of the Pacific.

The task of the study was to measure the congruency between an individual's concept of the self in employment and her perception of elementary teaching and to relate this congruency to the selection or rejection of elementary teaching. Several different techniques were employed to identify the subject's respective perceptions.

A form of Q-sort was used to determine the subject's perception of personal characteristics for the self and for elementary teachers. A statistical index denoted the congruency between these perceptions.

A similar form of Q-sort was used to determine the subject's perception of occupational features desired for the self and found in elementary teaching. A statistical index denoted the congruency between these perceptions.

Thematic apperception was used to measure the subject's perception of elementary teaching as an opportunity to satisfy her need for achievement or affiliation. The *n*-Achievement or *n*-Affiliation for each subject was ascertained from imaginative stories written in response to

three pictures of a general nature. The subject's perception of elementary teaching as a source of satisfaction for her respective needs was ascertained from imaginative stories written in response to three pictures of elementary teaching situations.

The subject's perception of others' attitudes toward elementary teaching was ascertained by having the subject indicate on a checklist those attitudes with which she thought the respective other group would be in agreement. An index of the subject's perception of others' attitudes toward elementary teaching was found by summing the scale values of these items.

The proposition that an individual selects a vocation which is perceived as a means of implementing the self concept was generally supported by the data. Elementary majors did tend to perceive elementary teaching as an appropriate vocation for their respective selves.

Other education majors, as contrasted to the noneducation majors, also perceived elementary teaching as an appropriate occupation. In effect the elementary majors and other education majors were not differentiated in the data and could be considered to be one population. It was suggested that both groups perceived the teaching situations as being within their chosen field.

The results of this exploratory study give impetus to further study of vocational choice from within the structure of self-psychology. Furthermore, there would seem to be some important implications for the recruitment of teachers.

The encouragement of persons to enter teaching would seem to be an individual process. Inasmuch as each person has a different self concept, teaching must be presented to each in terms of the variables of this self concept. Two of the most prominent variables to be considered are the individual's perceptions of personal characteristics and occupational features.

Microfilm \$2.00; Xerox \$6.40. 133 pages.

AN EXPLORATORY STUDY OF THE  
RELATIONSHIP BETWEEN THE GROWTH  
OF THE WHOLE CHILD AND AN ATTEMPT  
TO IMPROVE THE SOCIAL POWER OF  
SOCIOMETRICALLY REJECTED ELEMENTARY  
SCHOOL CHILDREN

(L. C. Card No. Mic 58-3702)

Nicholas James Long, Ph.D.  
University of Michigan, 1958

The purpose of this study is to explore the extent to which the growth of the whole child creates a readiness to accept or reject training for social learning as measured by sociometric changes in social power, likeability, and expertness. The need for the study is demonstrated by the increase of maladjustment among children and by the lack of objective methods for predicting which children will respond to help.

General hypothesis -- The general hypothesis is based upon research findings that children who grow at a rapid rate, at a high level, and in a unified pattern will show more improvement in integrating and utilizing a new experience than children who grow at a slow rate, at a low

level, and in a split pattern. Since there has not been any evaluation of growth theory in relation to social learning, the following hypothesis was posed:

The growth of the whole child plays a fundamental role in predicting the success or failure of any social learning program.

**Sample** -- The sample consisted of thirty-two experimental and sixteen control subjects from first through sixth grade. These subjects possessed low social power as defined by peer ratings, and had at least two consecutive measures in each of the seven growth indices (height, weight, grip, dental, carpal, mental, and reading).

**Experimental procedure** -- Four measures were used to estimate the growth of the whole child; longitudinal level, change in longitudinal level, longitudinal pattern and change in growth rate. The subjects were operationally divided into upper and lower experimental and control growth sub-groups. Sub-group one and two were respectively the upper and lower experimental growth groups. Sub-groups three and four were respectively the upper and lower control growth groups.

The experimental groups received twelve weekly one-hour role playing sessions intended to teach the children to understand the social behavior of others and to use multiple solutions in solving social problems. The control group received twelve one-half hour quiet game sessions. Sociometric ratings were taken at the beginning and end of the experimental time to indicate change in social status.

**Results** -- In order to test the general hypothesis, seventy-two specific predictions were posed. The nature of these predictions were as follows: sub-group one will make a significantly greater mean gain in the social variables than the mean gains of sub-groups two, three and four; sub-group three will make a significantly greater mean gain in the social variables than the mean gain of sub-group four; there will be no difference in the increase of the social variables between the mean gains of sub-groups two and three; and sub-group two will make a significantly greater mean gain in the social variables than the mean gain of sub-group four. These six predictions were repeated twelve times by alternating the three social variables (social power, likeability, and expertness) and the four growth variables.

1. The results of the statistical analysis did not support any of the seventy-two specific predictions beyond chance.
2. Further inspection of the results revealed a number of low positive values. The application of the sign test to these values showed a relationship between expertness and the four growth measures, significant at the one percent level.

**Conclusions** -- For the sample studied, differences in growth among children do not appear to be a basis for predicting which children will benefit from the experimental treatment. However, the significant relationship between expertness and the four growth measures, as indicated by non-parametric statistics shows a need for further study.

Microfilm \$2.35; Xerox \$8.20. 180 pages.

# THE INCARCERATED DEVIATED CRIMINAL SEX OFFENDER: HIS PERCEPTUAL RELATIONSHIPS WITH HIMSELF AND WITH SOCIETY

(L. C. Card No. Mic 58-3710)

Allen Menlo, Ph.D.  
University of Michigan, 1958

This study is concerned with the relationship between the incarcerated deviated criminal sex offender's perception of his ability to fulfill his important social needs, his perception of his potential to help himself with his own problem, his perception of society's feelings toward him, and the implications these findings may have for institutional re-education of the sex offender.

The writer designed three instruments of inquiry: (1) a scale to measure the sex offender's perception of his ability to fulfill his own needs, (2) an open-ended questionnaire to investigate the sex offender's own perceptions of himself, and (3) a set of projective cards to elicit the sex offender's perception of society's attitude toward him. These were used in interviews with a random sample of fifty sex offenders incarcerated at Ionia State Hospital. The three instruments were especially devised to explore the "here and now" perceptions and feelings of the sex offender rather than his psychogenetic personality determinants.

Statistical analysis of the data so secured was accomplished by the use of Chi square ( $\chi^2$ ), measure of probability (P), and the coefficient of contingency (C) throughout. Ten hypotheses dealing with relationships between various dimensions of the sex offender's total perception of himself were all substantiated.

The study indicates the existence of the following relationships: The sex offender who perceives himself as being able to fulfill his important social needs will also perceive society as feeling favorable toward him and will perceive himself as having potential to work at his own problem. In addition, the sex offender who perceives society as feeling favorable toward him and perceives himself as having potential to work at his own problem will (1) perceive society as being accepting and supportive toward him, (2) perceive representative institutions of society controlling his destiny (police, courts, law-makers) as being helpful toward him, (3) perceive society as seeing his behavior and its cause as being understandable, (4) favor open communication about sex offense to society, (5) see mental health knowledge as helpful to his own adjustment, and (6) employ himself as an object of study. On the other hand, negative perceptions and feelings of sex offenders on one dimension above are associated with negative perceptions and feelings on the other dimensions.

Speculations were made regarding the causal sequence between the measured sex offender perceptions and the relationship of this causal sequence to self perception theory. The conclusion was drawn that the task of the re-education agent, whose purpose is to help sex offenders return to a constructive place in society, is that of providing experiences by which the offender can achieve the feeling that he has the ability to fulfill his important social needs. Microfilm \$2.00; Xerox \$7.60. 165 pages.

**A STUDY OF THE PROGNOSTIC VALUE  
OF CERTAIN MEASURES OF  
INTELLIGENCE AND LISTENING  
COMPREHENSION WITH A SELECTED  
GROUP OF ELEMENTARY PUPILS**

(Publication No. 24,217)

Jason Camillous Owen, Ed.D.  
University of Missouri, 1957

Supervisor: A. Sterl Artley

**Purpose:** The purpose of this study was to determine the relationship between selected measures of intelligence, listening comprehension, and reading achievement as a basis for ascertaining the prognostic value of certain of these measures in estimating a pupil's present capacity for achievement in reading. Specifically, the purpose was to answer the following questions:

1. What is the degree of relationship between a measure of reading achievement and selected group measures of intelligence?
2. What is the degree of relationship between a measure of reading achievement and selected group measures of listening comprehension?
3. What is the degree of relationship between a measure of reading achievement and the combined measures of intelligence and listening comprehension?

**Procedure:** A measure of reading achievement, two group measures of intelligence, and two group measures of listening comprehension were administered to 160 pupils in grades II, III, and IV. Data obtained were treated to derive the following:

1. Product-moment coefficients of correlation between the measure of reading achievement and each of the group measures of intelligence and listening comprehension.
2. Multiple correlations to ascertain the combinations of a measure of intelligence and listening comprehension yielding the highest degree of relationship to measured reading achievement.
3. Beta coefficients giving the proportion of variance of reading achievement attributable to the combined measures.
4. Multiple regression equations for predicting reading achievement with measures of intelligence and listening comprehension.

**Conclusions:**

1. The California Test of Mental Maturity, Total Factors, and the Durrell-Sullivan Reading Capacity Test yielded approximately the same product-moment coefficients of correlation to reading achievement as measured by the California Reading Test. This relationship was described as "marked."
2. The action of the combined measures of the Durrell-Sullivan Reading Capacity Test and either the California Test of Mental Maturity or the Lorge-Thorndike Intelligence Test yielded a higher relationship to reading achievement as measured by the California Reading Test than either of these measures used separately. Less than 60 per cent of the vari-

ance of reading achievement could be attributed to the joint action of these two factors.

3. The action of the Durrell-Sullivan Reading Capacity Test ( $X_4$ ) and the California Test of Mental Maturity ( $X_2$ ) when used as a predictive index of reading achievement as measured by the California Reading Test ( $X_1$ ) provides the following regression equation:

$$X_1 = .40 X_2 + .39 X_4 - 6.64$$

The standard error of estimate was  $\pm 8.71$ .

4. The action of the Durrell-Sullivan Reading Capacity Test ( $X_4$ ) and the Lorge-Thorndike Intelligence Test ( $X_3$ ) when used as a predictive index of reading achievement as measured by the California Reading Test ( $X_1$ ) the following regression equation is presented:

$$X_1 = .47 X_3 + .51 X_4 + 12.27$$

The standard error of estimate was  $\pm 9.26$ .

**Educational Implications:**

1. A child's approximate level of reading expectancy can be more accurately obtained by using a combination of measures of intelligence and listening comprehension than by using a single group measure of intelligence and listening comprehension.
2. Though a combined measure of intelligence and listening comprehension appears to yield a more adequate prediction of reading achievement than any one of these measures used separately, it is not of sufficient magnitude to rule out the action of many other factors that operate in determining reading achievement.

Microfilm \$2.00; Xerox \$6.40. 133 pages. Mic 58-5075

**A STUDY OF DROP-OUTS FROM THE  
JUNIOR DIVISION OF LOUISIANA STATE  
UNIVERSITY, 1953-1955**

(L. C. Card No. Mic 58-2849)

Ben Keaton Patton, Jr., Ph.D.  
Louisiana State University, 1958

Supervisor: Professor William Rodney Cline

A study was made of all new students from the entire population of drop-outs and non-drop-outs from the Junior Division of Louisiana State University for 1953-1954 and 1954-1955. Drop-outs totaled 943 and 848, respectively, for the two years. Non-drop-outs totaled 1,043 and 1,162, respectively, for the two years. The total number of students studied was 3,995.

The principal problem was to determine whether twenty-one selected factors were significantly related to dropping out for 1953-1954 and 1954-1955. Analysis of drop-outs for each factor was made by the chi-square technique. The five per cent level was the standard.

The factors that did not have significant relationships to dropping out for 1953-1954 or 1954-1955 were:

1. Residence status.
2. Veteran status.

3. Transfer status (to Louisiana State University).
4. High school enrollment.
5. High school accreditation.
6. Proposed area of study at Louisiana State University.

The factors that had significant relationships to dropping out for one of the years, 1953-1954 or 1954-1955 were:

1. Age at entrance to Louisiana State University.
2. Marital status.

The factors that had significant relationships to dropping out for 1953-1954 and 1954-1955 were:

1. Sex: Males were associated with dropping out.
2. Occupation of father: Students with fathers in categories of lower socio-economic status dropped out more than students with fathers in categories of higher socio-economic status.
3. Point-credit ratio for first term at Louisiana State University: Low grades were associated with dropping out.
4. English point-credit ratio for first term at Louisiana State University: Low grades were associated with dropping out.
5. Mathematics point-credit ratio for first term at Louisiana State University: Low grades were associated with dropping out.
6. Quantitative score on American Council on Education Psychological Examination: Low scores were associated with dropping out.
7. Linguistic score on American Council on Education Psychological Examination: Low scores were associated with dropping out.
8. Reading score on Cooperative English Test: Low scores were associated with dropping out.
9. Mechanics of Expression score on Cooperative English Test: Low scores were associated with dropping out.
10. Effectiveness of Expression score on Cooperative English Test: Low scores were associated with dropping out.
11. Cooperative Algebra Test score: Low scores were associated with dropping out.
12. Arithmetic score on General Chemistry Placement Examination: Low scores were associated with dropping out.
13. Chemistry score on General Chemistry Placement Examination: Low scores were associated with dropping out.

Also, an analysis of the total number of drop-outs and non-drop-outs in each category of each factor was made in relation to the total number of students for each factor.

Analysis of drop-out times for 1953-1954 and 1954-1955 revealed that most drop-outs occurred at the end of the students' second term. (A term refers to the fall semester, or to the spring semester, or to the summer session of the academic year.) Drop-outs at the end of the first and second terms totaled about half of all the drop-outs. About ninety-five per cent of all drop-outs occurred by the end of the fourth term.

In addition, an analysis of transfer status revealed that about three-fourths of the drop-outs apparently did not transfer to other institutions of higher learning upon dropping out since no transcripts were sent.

With knowledge of the relations of the factors and categories to dropping out, counselors in the Junior Division of

the University may be able to better assess the chances of an individual counselee remaining in college. Counselors in Louisiana high schools may use this information in advising high school students concerning college success.

Microfilm \$2.10; Xerox \$7.40. 157 pages.

# AN ANALYSIS OF THE PERSONALITY STRESSES OF NEGRO AMERICANS AND THEIR IMPLICATIONS FOR EDUCATION

(L. C. Card No. Mic 58-3082)

Ronald J. Roussève, Ph.D.  
University of Notre Dame, 1958

This study is a critical and evaluative analysis of the personality tensions experienced by Negro Americans and the educational implications related thereto. Especially in recent years have educators begun to perceive the singular pedagogical significance of investigations of this type, for it is now generally accepted that a given student cannot learn efficiently—nor realize an adequate measure of self-fulfillment as a citizen in a democratic social order—if he must also cope with social and emotional handicaps of no little magnitude.

The social-psychological and educational issues treated in this study were abstracted, in the main, from a critical analysis of the results of previous studies designed to determine the personality consequences of being a Negro in America. Hence, a part of the study's uniqueness lies in its "interdisciplinary" character—in the fact that its educational considerations flow from social-psychological materials which heretofore have not been utilized to any great extent as sources of valuable pedagogical insights.

In Part I of the inquiry an effort is made to analyze meaningfully the unique adjustment difficulties faced by Negroes in the United States by considering them in the light furnished by a broad framework of contemporary principles of personality formation and human socialization. It is discovered that Negro Americans invariably perceive social and cultural clues which enable them to attach significance to themselves as "different," and that they learn early to limit their expectations of freedom of movement and gratification of desires in the larger society. In short, the discrimination imposed on these individuals means that their self-esteem suffers because they are constantly receiving unpleasant images of themselves from the behavior of their white compatriots.

It is also revealed that closely intertwined with the peculiar behavioral reactions acquired by the Negro in America there is a nucleus of interrelated cultural factors which appear to hold particular significance for education. These crucial elements which invariably tend to cause Negroes to depreciate themselves (to acquire unwholesome conceptions of themselves) are: (1) the yoke of inferiority and related stereotypes, (2) color valuations and high visibility, and (3) the inadequate treatment of the constructive performances of Negroes in American life and history.

Part II of the study focuses more directly upon the educational considerations contained in the personality stresses of Negro Americans. One of the principal findings here is that if American education is to serve as a

major instrument of democracy in a new era of scientific-technological advancement and of East-West tension, educators must confirm the central place that human relations should hold in a modern philosophy of education for a democratic society, and they should recognize that the crucial significance of the individual's conceptions of himself represents an important principle around which needed educational changes might be structured.

It is also revealed that the distortion and exclusion of the objective facts relative to the achievements and contributions of Negro Americans to the advancement of human civilization from the typical instructional resources used in American schools, suggests the need for a prudent selection of unbiased curricular materials on all levels of the educational ladder.

Another finding is that various instructional and administrative plans which tend to set up divisive social-cultural groups within the school or which tend to reinforce the traditional power relations surrounding the two major racial groups in the American social order can only result in a stratification that is destructive of intergroup harmony and scholastic efficiency.

Other conclusions relate to problems of a motivational character, to teacher selection and training, and to effective democratic procedures in the school situation.

Microfilm \$3.70; Xerox \$12.00. 286 pages.

## EDUCATION, TEACHER TRAINING

### THE RELATIONSHIP BETWEEN SUCCESSFUL STUDENT TEACHING AND PRE-STUDENT TEACHING EXPERIENCES WITH CHILDREN

(L. C. Card No. Mic 58-3656)

Emilio Quial Edualino, Ph.D.  
University of Michigan, 1958

The purpose of this study has been to determine the relationship between experiences with children prior to student teaching and success in student teaching.

A check list was used to find out how much experience with children student teachers have prior to student teaching. The hours of experience while they were in high school and in college, the role they played, and the extent of supervision they had while gaining these experiences were considered. Success in student teaching was determined primarily through a rating scale. Other measures of success used were a satisfaction - dissatisfaction scale and a check list of problems perceived by students during their student teaching.

By using the Pearson product moment correlation, the multiple correlation, and the Fisher t distribution, significant positive relationships were found to exist between:

1. Success in student teaching and church related experiences with children during high school years; and,
2. Satisfaction with student teaching and hours of experience with children.

Significant negative relationships were found to exist between:

1. Hours of experience with children and frequency of occurrence of problems related to instructional methods and understanding of objectives in particular school subjects; and,
2. Hours of experience with children and degree of difficulty of problems related to school discipline and adjustment to children.

Insignificant relationships were found to exist between:

1. Success in student teaching and the role which students played as they gained experiences with children; and,
2. Success in student teaching and the extent of supervision students had as they gained experiences with children.

The following conclusions are supported by the data gathered in this study based on the particular students included in the sampling:

1. Students who have had experiences with children in church related activities during their high school years are more successful as student teachers than those who did not have these experiences.
2. The more the hours of experience a student has with children prior to student teaching, the less frequent is the occurrence of problems related to instructional methods and understanding of objectives in particular school subjects.
3. Students with more hours of experience with children prior to student teaching find it easier to solve their problems on school discipline and adjustment to children than those students who have fewer hours of such experience.
4. The more hours of experience the student has with children prior to student teaching, the better satisfied he is with his student teaching.
5. The role which the student plays and the extent of supervision he gets as he gains experiences with children prior to student teaching do not influence his success, his satisfaction, or the problems he perceives as a student teacher.
6. Aside from these specific findings, the number of hours of experience with children has generally no significant relationship with a student teacher's success, his satisfaction, and the problems he perceives in student teaching.

Microfilm \$2.35; Xerox \$8.20. 180 pages.

# A STUDY TO DETERMINE THE EFFECTS OF TRAINING AND PRACTICE ON DRAKE MUSICAL APTITUDE TEST SCORES

(L. C. Card No. Mic 58-2959)

Edwin Gordon, Ph.D.  
State University of Iowa, 1958

Chairman: Associate Professor Neal E. Glenn

Since music educators use standardized musical aptitude tests to assess innate musical ability and to select participants for music programs, it is essential that scientific evidence be brought to bear on the feasibility of this practice. In line with this, the problem of this study was to determine 1) whether scores on the Drake Musical Aptitude Tests are affected by training and practice and 2) whether high scoring students would lose their advantage over low scoring students on the Musical Memory Test after training and practice. The correlation between the two subtests, Musical Memory and Rhythm, was computed.

Twenty ninth grade students participated in the experiment. Of these experimental subjects, ten initially achieved percentile ranks ranging from one to thirty-six and the remaining ten achieved percentile ranks ranging from fifty to seventy-five on the Musical Memory Test. Five of the high scoring students and five of the low scoring students were selected at random to serve as the experimental group and receive training. The remaining ten students comprised the control group and received no training.

The training period consisted of twenty lessons, each lasting one-half hour. The lessons extended over a period of one month. Exercises composed by the writer were used for training purposes. Both groups were retested on the Rhythm and Musical Memory Tests at the end of the training period.

For the evaluation of training and practice effects, the technique of analysis of covariance was used. The same techniques were employed for comparing progress of initially high and low scoring subjects. Data for the two groups were also treated independently to test the significance of the gain from pretest to post test on the two tests. The latter analysis was undertaken only to provide evidence of a type which has often been derived from training experiments and to emphasize the fallacious conclusions that may be derived from a training experiment performed without a control group. Sixty-five pretest scores were used for correlation purposes.

Although the experimental group and the initially high scoring students made the greater gains after training and practice, the null hypothesis, with respect to the difference in gains, could not be rejected at the five percent level of confidence.

When the experimental and control groups were treated independently, both groups made statistically significant gains on the Musical Memory Test at the five percent level of confidence. However, the null hypothesis, with respect to gains on the Rhythm Test, could not be rejected at the five percent level of confidence.

The correlation between the Musical Memory and the Rhythm Test was .315.

On the basis of the foregoing statistical evidence, it appears for the present time that the Drake Musical Aptitude Tests are not sensitive to training and practice effects and that they cannot be considered tests of musical achieve-

ment. The obtained correlation between the Musical Memory and Rhythm Tests tends to corroborate Drake's point of view that each test measures an independent factor within the concept of musical aptitude.

The evidence from the analysis of independent groups points to the fact that many studies done in the past without a control group yield misleading results pertaining to the measurement of musical aptitude.

Microfilm \$2.00; Xerox \$4.60. 89 pages.

## REASONS FOR TEACHER DISMISSAL IN PUBLIC SECONDARY SCHOOLS OF IOWA

(L. C. Card No. Mic 58-2960)

Le Roy H. Griffith, Ph.D.  
State University of Iowa, 1958

Chairman: Associate Professor J. E. McAdam

### Purposes of the Study

The major purposes of this study were: (1) to ascertain the factors that contributed to the dismissal of a group of Iowa secondary school teachers, and, (2) to compare this group of dismissed teachers with a group of reappointed teachers on various personal and professional factors.

### Procedures

Reasons for the dismissal of 283 secondary school teachers were obtained in personal interviews with 214 Iowa school superintendents. The dismissed teachers had been dismissed during the five year period which extended from the 1952-3 to the 1956-7 school years. For each of 243 of the dismissed teachers, a reappointed teacher was selected by the superintendents, and a special study was made of the characteristics, attitudes, and responsibilities of these 486 teachers. The reappointed teachers were equated with the dismissed teachers for sex, experience, and, where possible, by college attended.

Ratings were obtained for the dismissed and reappointed teachers for each of thirteen traits. The rating scale was administered to the superintendents during the interviews.

A group of thirty-five dismissed teachers were interviewed personally in order to compare their reasons for leaving the schools with those given by the superintendents, and to obtain their answers to questions designed to obtain statements of their attitudes, and their cooperation in completing the California Psychological Inventory, and an attitude scale. For a group of thirty-seven reappointed teachers similar data were obtained by personal interviews and by questionnaire.

In an effort to ascertain whether it would be possible to predict that a given teacher would be reappointed or dismissed, an analysis was made of five grade point averages obtained from the transcripts for each of 158 reappointed and 158 dismissed teachers. A similar analysis was made of the responses of 27 reappointed and 27 dismissed teachers to the California Psychological Inventory.

### Conclusions

As in earlier studies of teacher dismissal, this study shows that inability to control pupils remains a major factor in teacher dismissal. However, dismissal for immoral acts ranks higher among the reasons for dismissal in this study than in previous studies.

There is a greater tendency for women teachers, than for men, to be dismissed for reasons of poor staff relationships, eccentric behavior, poor health, unsatisfactory personal habits, and neglect of duties.

The probability of being dismissed increases inversely with the size of the school.

If teachers are to be dismissed from a school system, the probability is greatest that they will be dismissed their first year in that school system.

In discussing with teachers who are in danger of dismissal the ways they can improve, administrators tend to avoid making clear cut suggestions.

The chances are two to one that teachers will be allowed to resign from their positions as opposed to being informed by mail that their contracts have been terminated.

Teachers who have been dismissed seem to be cognizant of the reasons for dismissal whether the reasons are clearly stated by school officials or not.

Married women teachers, who are residents of the community where they are employed, or have been residents for a few years prior to their employment, tend to be dismissed less frequently than unmarried women teachers.

Administrators seem to be better able to distinguish between reappointed and dismissed teachers in an overall sense, than they are to describe specific traits or characteristics of either group.

Teaching outside one's major and minor fields does not lead to dismissal any greater percentage of the time than does teaching in one's major field.

Teachers, whose performance is unsatisfactory enough in the opinion of school officials to warrant dismissal, tend not to have the respect of their colleagues, pupils, and patrons.

Failure to be reappointed to a position in one school system does not seem to lessen, significantly, a teacher's chances of being appointed to a position in another school system.

The chances are greater that dismissed teachers will be involved in fewer community activities than reappointed teachers.

It appears that more attention in the development of in-service education programs, which would include regular and systematic supervision, conferences with teachers, workshops, orientation activities, and the like, would tend to lessen the necessity for dismissal.

Microfilm \$3.45; Xerox \$11.80. 266 pages.

### A DESCRIPTIVE AND CRITICAL ANALYSIS OF FLORIDA'S TEACHER EDUCATION ADVISORY COUNCIL

(L. C. Card No. Mic 58-2795)

William Lewis Maloy, Ed.D.  
The Florida State University, 1958

An exploratory study was made of Florida's white Teacher Education Advisory Council. Primarily, the study involved descriptive analysis with particular reference to the organizational and operational procedures employed by the Council, 1937 through June, 1957.

Important aspects of the study were:

Search of professional literature for established guidelines of democratic leadership and administration.

Formulation of tentative statements of principles that should guide the organization and operation of councils on teacher education.

Organization of the tentative statements into an instrument for jury use.

Pre-test of the instrument.

Distribution of the instrument to a selected jury of state school officials in the forty-eight states.

Tabulation of jury responses and selection of principles to use in analyzing the function, organization, and administration of Florida's Council.

Use of the validated principles as criteria in estimating the extent to which Florida's Council has been conducted in keeping with these principles.

Primary sources were unpublished records of the Council, persons associated with the Council, and Florida's Statutes.

Three quantitative statements were used to indicate the extent to which the validated principles were operative. They were:

Readily identifiable: much evidence that Florida's advisory group consistently has operated in keeping with this principle.

Partially identifiable: some evidence that the Council is operating in a manner harmonious with the principle, or, evidence that the Council is moving toward action harmonious with the principle.

Not identifiable: little or no evidence could be found to indicate action consonant with the principle.

Readily identifiable in the organization and operation of Florida's Council were those professionally acceptable criteria relating to the:

Identification of problems.

Coordinative efforts between agencies.

Use of technical assistance.

Encouragement and use of research.

Initiation of change through enlightenment.

Advisory functions of councils.

Agency representation on councils.

Professional membership on councils.  
 Three year term of membership for delegate representatives.  
 Acquisition of membership exhibiting real concern for teacher education improvement.  
 Appropriation of funds by agencies for representatives attending council meetings.  
 Need for a state department fund to reimburse representatives for expenses incurred in attending council meetings.  
 Regularly constituted financial channels to initiate and continue council-endorsed programs.  
 Election of officers.  
 Appointment of a steering committee.  
 Coordination of activities through standing and specially appointed committees.  
 Utilization of available talent in the solution of problems.  
 Systematic compilation of records.  
 Effort to achieve group consensus.  
 Number of meetings held annually.  
 Length of council meetings.  
 Scheduling of meeting time with reference to other organizations.

Partially identifiable were those criteria relating to the:

Dissemination of information to member agencies.  
 Established means of sharing experiences with other states.  
 Promotion of regional and national meetings.  
 Selection of representatives.  
 Number of terms a delegate would serve on a council.  
 Specific occupational distribution of council membership.  
 Rules governing the conduct of a council.

Not identifiable were those criteria relating to the:

Dissemination of information to the general public.  
 Program for arousing public interest in teacher education.  
 Inclusion of lay public representatives as responsible members.

Ample evidence was found to warrant the conclusion that Florida's white Teacher Education Advisory Council has developed a pattern of professional operation harmonious with principles of democratic leadership and administration.

Major accomplishments of the Council are:

Promotion and coordination of a state-wide off-campus student teaching (Internship) program.  
 Development of the Internship Handbook.  
 Recommended administrative and instructional personnel certification regulations adopted by the State Board of Education in 1938 and since.  
 Development of State accreditation standards for teacher training programs in Florida.  
 Sponsored numerous state-wide teacher education conferences.

Microfilm \$2.30; Xerox \$8.00. 174 pages.

## A COMPARISON OF DRAFTING PRACTICES IN INDUSTRY WITH DRAFTING AS TAUGHT IN ENGINEERING SCHOOLS

(Publication No. 24,218)

Stephen Vincent Randel, Ed.D.  
 University of Missouri, 1957

Supervisor: H. H. London

**PURPOSE OF STUDY:** The purpose of this study was to compare drafting as taught in engineering colleges with the drafting practices followed in selected machinery manufacturing industries.

**METHOD OF RESEARCH:** Information forms were prepared and sent to drafting instructors in engineering schools and to chief draftsmen in machinery manufacturing industries throughout the nation. These forms contained questions concerning lettering, use of instruments, dimensioning, thread representation, graphs, charts, and drawing procedures. The data were tabulated on IBM cards.

**SUMMARY:** A large majority of lettering done in schools and industry was freehand; however, a higher degree of legibility for freehand lettering was required in schools than in industry.

Considerably more lettering devices and machines were used in industry than in schools for improving lettering and drawing techniques.

A considerably larger number of respondents from schools gave instruction in the use of the T-square than the number who used this device in industry.

More pictorial drawings were made by respondents from schools than by those from industry.

The majority of original drawings made in schools and industry were made on tracing paper in pencil. Very few ink drawings were made by either group.

A majority of respondents from industry used an italic "f" on finish surfaces on drawings, while the symbol V was used on the majority of drawings made in schools.

Simplified drafting procedures were not practiced to any great extent by either group.

Respondents from schools indicated a greater preference for using the aligned system for dimensioning vertical distances, while more respondents from industry used the unidirectional method on their drawings.

Considerably more diagrams and charts were made in industry than in schools.

Respondents from industry advocated more experience in shop processes and industrial procedures, better instruction in freehand lettering and drawing techniques, more mathematics and science courses, and more training in simplified drafting procedures for drafting students.

Respondents from engineering schools advocated more fundamentals of drawing theory and projection, and less time and effort in developing drawing skills and techniques.

The largest percentage of respondents from industry received their most advanced training in drafting from an engineering school.

**CONCLUSIONS:** There are various discrepancies in the drafting practices followed by machinery manufacturing industries and drafting as taught in engineering schools.

Drafting students in engineering schools appear to execute a greater variety of lettering than do draftsmen in industry, although both groups use freehand lettering almost exclusively.

It is apparent that considerably more drawing and lettering devices and machines are used in industry than in schools for improving lettering and drawing techniques.

Students in engineering schools seem to make more pictorial drawings than do draftsmen in industry.

A major difference in the method of noting finish surfaces on original drawings appears to be in the use of an italic "f" on drawings made in industry, as compared with the greater use of the symbol  $\nabla$  in schools.

Differences in dimensioning practices in schools and industry would appear to be only moderate.

A greater variety of graphs, charts, and diagrams seem to be made in industry than in schools.

In view of the opinions expressed by draftsmen in industry, it would appear that the training program for drafting students could be improved by providing more experiences in shop processes and industrial procedures, and better instruction in freehand lettering and drawing techniques.

There appears to be a definite trend in engineering education for greater emphasis upon fundamentals of drawing theory and projection, problem solving, and freehand drawing, and less emphasis upon developing manipulative drafting skills among drafting students.

Microfilm \$3.10; Xerox \$10.60. 239 pages. Mic 58-5076

#### TEACHING LOAD OF TEACHERS OF SCIENCE IN OREGON

(L. C. Card No. Mic 58-3060)

Richard Franklin Thaw, Ed.D.  
Oregon State College, 1958

Major Professor: Stanley E. Williamson

In this study, questionnaires were sent to secondary school principals and science teachers in Oregon in an effort to determine (1) the extent to which teachers in Oregon meet state minimum requirements for background training in the basic sciences, (2) the amount of time science teachers spend in planning and organizing materials of instruction, (3) the amount of time science teachers spend in teaching and the amount of time they spend in extra-curricular duties, (4) the number of different daily preparations required of the science teachers, (5) the extent to which science teachers sponsor science fair and related projects, and (6) the average daily enrolment of pupils met by science teachers.

Questionnaires from 424 science teachers and 215 principals made up the sample which represents sixty-eight per cent return from teachers and eighty-four per cent return from principals.

Only two-thirds of the science teachers meet the present minimum state standards in the science areas.

One daily period free of any teaching duties is assigned to thirty-seven per cent of the science teachers. Forty-

nine per cent of the science teachers teach five periods a day. The state minimum required class period of fifty-five minutes in length was indicated by three-fourths of the science teachers reporting. Eight per cent of the teachers have class periods of sixty minutes.

Two-thirds of the science teachers work more than six hours a week outside of class in preparation for teaching.

Extra-curricular duties requiring time outside the regular school day and club activities during school hours involve all of the science teachers. About eighty-two per cent of the science teachers spend from one to fifteen hours a week in out-of-school activities.

The number of different daily teaching preparations range from one to six preparations daily. Distribution of teachers is almost evenly divided between one, two, three, and four or more preparations per day.

Less than one-half of Oregon's science teachers take an active part in science fairs.

Eighty-one per cent of the science teachers meet fewer than 161 pupils each day.

Microfilm \$2.00; Xerox \$5.60. 115 pages.

#### EDUCATION, THEORY AND PRACTICE

##### BOOKKEEPING ACHIEVEMENT AS RELATED TO INSTRUCTIONAL METHODOLOGY

(L. C. Card No. Mic 58-1979)

Thomas B. Maier, Ed.D.  
Temple University, 1957

##### The Problem and Its Importance

The purpose of this study was to survey first-year bookkeeping teaching practices and circumstances and to determine if these factors were related to achievement in bookkeeping as determined by scores on a series of bookkeeping tests developed in connection with the study. The over-all purpose was divided into three problems: (1) to determine the level of achievement in a large number of bookkeeping classes; (2) to survey by questionnaire the extent to which certain techniques and circumstances connected with methodology were employed in teaching first-year bookkeeping classes; (3) to determine whether a relationship existed between achievement by the classes and the techniques and circumstances under which they were taught.

Bookkeeping is a body of dynamic subject matter. Teachers of bookkeeping, caught in a flux of changing course content and methods, are ever seeking a set of standards by which they may measure the effectiveness of their own teaching. This study purports to provide a survey of practices by which they may judge their own and to establish normative standards of achievement by which they may evaluate the work of their classes.

##### Procedure in the Solution of the Problem

Data were accumulated from two main sources: over 37,000 individual test scores, used to measure achievement; and replies to a 47-item questionnaire from 317 cooperating teachers, used to survey instructional methodology and circumstances.

It was necessary, first, to build in accordance with established procedures a series of seven objective achievement tests to measure bookkeeping achievement in the various classes.

Secondly, an objective questionnaire was developed and distributed to a large group of teachers who had reported scores on the achievement tests in order to ascertain the methodology practices that were extant in the teaching of bookkeeping.

Finally, the classes were divided into four groups according to achievement on the test series, and the extent to which each item of methodology was employed by the top achieving group and the bottom achieving group was compared and subjected to a Chi-Square test to determine if a statistically significant relationship existed.

### Summary

1. Normative standard scores were established for the test series, and coefficients of reliability ranging from .90 to .99 were computed.

2. Most teachers employed the following practices in teaching bookkeeping:

(a) Used the textbook, blackboard illustrations, and oral questions during presentations of new units; gave oral drill and informal check-up tests often; counted penmanship and class work in grades; assigned homework 37 minutes in length; utilized student business experiences, taught only one bookkeeping class of 19 pupils for 51 minutes at the 11th or 12th grade level but taught three other subjects; had specific methodology training, had taught for 5 years; had taken 9 hours of college accounting.

(b) Required students to study textbook illustrations thoroughly; to complete work in their best penmanship and in ink; to prepare answers to end-of-chapter questions before completing all chapter problems; to solve three textbook projects; to use the workbook and practice sets.

3. Most teachers did not:

(a) Prepare blackboard illustrations in model penmanship; use cardboard column headings for blackboard illustrations; take classes on field trips; have business men lecture to classes; use Cram wall charts; use film strips; use films.

(b) Require students to read aloud from textbooks; to solve all supplementary problems; to solve problems on the blackboard.

4. A statistically significant relationship between achievement in bookkeeping and certain items were noted; the top achieving group reported with greater frequency that:

- (a) Teachers presented new units with textbooks closed.
- (b) Teachers gave oral drill more regularly.
- (c) Students were taking bookkeeping at a higher grade level.
- (d) Teachers were teaching bookkeeping for two or more years.
- (e) Teachers had 7 or more hours of college accounting.
- (f) Practice sets with business papers were used.
- (g) Films on bookkeeping were used.

Microfilm \$2.85; Xerox \$9.80. 218 pages.

## AN ANALYSIS OF THE VALUE OF THE CORRECTED TEST AS A TECHNIQUE FOR PRESENTING SPELLING INSTRUCTION

(L. C. Card No. Mic 58-2981)

Martin Schaefer, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Herbert F. Spitzer

The purpose of this investigation was to compare the efficiency of three methods of presenting spelling instruction. One of these methods, known as the study-test method, provided for study before the pupils were tested on the week's word list. The second method was a test-study method in which the pupils were tested on the word list prior to commencing study of the words for the week. The third method, designated as the corrected-test method, was distinguished by the class activities on the first day. Prior to study of the words, the pupils using this method wrote the spelling list from dictation, corrected their own papers, and then retook the test on the word list.

The subjects supplying complete sets of data for this study consisted of 591 fourth grade pupils and 589 sixth grade pupils attending the Beloit, Wisconsin Public Schools. Included in the experiment were twenty-three classes at the fourth grade level and twenty-two classes at the sixth grade level.

The words used for the experimental study were part of the regularly assigned spelling lists in the fourth and sixth grades, respectively. Each teacher taught spelling only by the assigned method, and only for the regularly allotted time, during the five weeks of the experiment.

To measure the learning taking place through the use of each technique, pupil performance was evaluated by comparing scores on a fifty word pretest, given prior to the start of the study, with scores on the same fifty word test used as an immediate-recall test on the last day of the experiment. To obtain a measure of how well the spellings of the words studied under each method were retained, the same fifty word test was administered to all pupils, as a delayed-recall test, three weeks after the study was concluded.

The results of this investigation were analyzed separately at each grade level. The analysis of variance was the statistical technique utilized to compare the relative efficiency of the three methods of teaching spelling. Results were analyzed for the entire group of students taught by each method at the respective grade levels, and also, at four levels of initial spelling ability as determined by the percentage of words each pupil spelled correctly on the pretest.

The data obtained in the present investigation lend support to the following conclusions:

1. As determined by the amount of gain measured on the recall tests, there were no significant differences at the Fourth Grade level in the results obtained from teaching spelling by the three methods used in this study.

2. As determined by the amount of gain measured on the recall tests, pupils at the Sixth Grade level taught through use of the Corrected-Test Method showed consistent gains over those taught by the Test-Study and the Study-Test Methods. The difference in gain between the

Corrected-Test Method and the Study-Test Method was significant at the 5 percent level of confidence.

3. The measure of spelling ability through use of a multiple-choice type test in which the pupil selects the misspelled word resulted in lower scores than measures of spelling ability of the same pupils through use of a conventional list type test. This difference in scores was significant at the 5 percent level of confidence.

The results of this investigation seem to warrant the recommendation that the Corrected-Test Method can be an effective technique for presenting spelling instruction on the first day. It may be especially effective when used with the poorer spellers at the intermediate grade levels.

Microfilm \$2.40; Xerox \$8.40. 181 pages.

**AN EXPERIMENTAL STUDY OF  
ACHIEVEMENT IN ARITHMETIC AND THE  
TIME ALLOTTED TO DEVELOPMENT OF  
MEANINGS AND INDIVIDUAL PUPIL PRACTICE**

(L. C. Card No. Mic 58-2850)

Donald Eugene Shipp, Jr., Ph.D.  
Louisiana State University, 1958

Supervisor: Professor George H. Deer

The amount of class time which teachers allot to different activities in teaching arithmetic varies considerably. This study sought to determine whether varying the per cent of class time devoted to developmental activities and to individual practice work would affect achievement in arithmetic.

A simple treatments-by-levels experiment was set up in each of grades four, five and six. There were four treatments assigned randomly to four sections of pupils in each grade. The four sections in each grade were "matched" at upper, middle and lower thirds on mental ability. This constituted the three levels in the experiments. The four treatments differed in the per cents of class time allotted to developmental work and to practice work.

Treatment A allotted 75 per cent of class time to developmental work; Treatment B, 60 per cent; Treatment C, 40 per cent; and Treatment D, 25 per cent. The remainder of the class time in each treatment was devoted to practice work. The same teacher taught the four sections in each grade, adjusting the activities for each sec-

tion to fit the assigned treatment. In each grade the teacher attempted to present a meaningful program of arithmetic as recommended by the adopted textbook and teacher's manual.

In May, 1957, the Henmon-Nelson Test of Mental Ability was given to all pupils in the school who were to be promoted to the fourth, fifth and sixth grades for the next school year. The sections in each grade were made up by random assignment of an equal number of pupils from the upper, the middle and the lower third of each grade according to mental ability. Four of these "matched" sections were then selected for use in the study.

In September, 1957, the Silver Burdett Achievement Tests in arithmetic were given to all sections. These tests provided scores on understanding arithmetic, computational skill, problem solving and total achievement. After the sections had been taught for twelve weeks in accordance with the treatments assigned them, another form of the arithmetic tests was administered.

By using analysis of covariance, final test scores were adjusted in terms of initial test scores to eliminate initial differences in arithmetic ability between the sections in each grade. Variances of the adjusted final scores were analyzed and the F-test applied to determine whether the differences between the means of the various treatments were significant. In each grade, treatments were compared as to their effect on achievement on the three parts of the test and on total score.

Significant differences were found in the achievement of the sections in all three grades. Data in the study support the following findings:

1. Pupils in the groups that devoted 75 per cent or 60 per cent of their class time to developmental work achieved significantly higher on total score than pupils in groups that devoted a lesser per cent of class time to developmental work.
2. Pupils in these same groups achieved significantly higher on understanding arithmetic and on computational skill.
3. Differences between the treatments on problem solving were not found to be significant to this study.
4. Tests of the significance of the interaction effects of the treatments and levels did not show the effects of the treatments to be different at the three ability levels.

The results of this study seem to justify a conclusion that if 60 to 75 per cent of arithmetic class time is devoted to developmental activities in the middle elementary grades then pupils will tend to show maximum achievement on a general achievement test in arithmetic.

Microfilm \$2.00; Xerox \$5.60. 111 pages.

## ENGINEERING

### ENGINEERING, AERONAUTICAL

#### THERMAL BUCKLING OF CIRCULAR CYLINDRICAL SHELLS UNDER CIRCUMFERENTIAL TEMPERATURE GRADIENTS

(L. C. Card No. Mic 58-2861)

David Abir, Ph.D.

Polytechnic Institute of Brooklyn, 1958

Adviser: N. J. Hoff

Co-adviser: S. V. Nardo

The purpose of the investigation is to evaluate the thermal buckling of thin-walled circular cylindrical shells due to axial stresses which are caused by variations of the temperature distribution around the circumference.

The problem of structural stability of thin cylindrical shells under thermal stresses has attained importance in aeronautical engineering, since the structures of the bodies of high-speed airplanes and missiles often have the shape of such shells, and are subjected to high rates of aerodynamic heating.

The analysis is carried out with the aid of Donnell's equations which are accurate enough for engineering purposes when the wave length of the buckled shape is smaller than the radius of the cylinder. The numerical calculations presented in this report prove that this condition is satisfied in cylindrical shells of interest to the aircraft designer. The distribution of the thermal stress is assumed to be constant through the thickness and in the axial direction. Its variation with the circumferential coordinate is represented by Fourier series. The analysis is followed up by experimental work on cylinders with longitudinal stiffeners subject to a uniform heat input, and on non-reinforced cylinders subject to a circumferential variation in heat input.

The conclusion reached is that the critical value of the axial compressive stress under variable thermal stress conditions does not differ much from the critical stress of the cylinder when it is subjected to uniform axial compression if the variation of the intensity of the thermal stress within one-half wave length is not large. This conclusion is not unexpected on physical grounds, but it is significant because it permits the approximate evaluation of the critical condition without any lengthy calculations.

Microfilm \$2.00; Xerox \$5.20. 101 pages.

#### THE SIMULATION OF A GUST IN A WIND TUNNEL BY MEANS OF A MOVING BUMP

(L. C. Card No. Mic 58-3661)

Louis Charles Garby, Ph.D.

University of Michigan, 1958

This dissertation comprises a description of the development and testing of a method of producing gust-type disturbances in a wind tunnel and the application of the method to the measurement of the lift lag experienced by a two-dimensional wing while traversing a gust.

A two-dimensional "bump" is moved along the floor of the wind tunnel section to generate the gust. The streamlines are strongly curved in the region ahead of the bump. An airfoil is mounted ahead of the bump so that as the bump is moved downstream the inclination of the streamlines decreases and therefore the angle of attack of the airfoil decreases with time. The lift of the airfoil in this unsteady flow field is measured and compared with theory. Angles of about four and one-half degrees per chord travel were produced. The lift lag associated with the unsteady flow was obtained by subtracting the force obtained when the bump was fixed in several positions from that obtained while the bump was moving.

Comparison is made between the experimental lift lag results and theoretical results. The agreement between experiment and theory is good, after a correction for the tunnel wall boundary effect is made.

The Reynolds number range through which the experiments were conducted was from 93,000 to 465,000. For the lower range of Reynolds numbers a 6-inch chord wing was tested in a 21 x 24 inch open return tunnel. The higher Reynolds numbers were tested on a 12-inch chord wing mounted in a 5 x 7-foot closed return tunnel.

Details of the balance system and bump accelerating mechanism are given along with the recording techniques.

Microfilm \$2.00; Xerox \$3.60. 65 pages.

#### ON THE STABILITY OF ONE-DIMENSIONAL VISCOUS, COMPRESSIBLE FLOWS: SOUND WAVES AND SHOCK WAVES

(L. C. Card No. Mic 58-2869)

Louis Graveraet Kaufman II, Ph.D.

Polytechnic Institute of Brooklyn, 1958

Adviser: Morris Morduchow

The solution to the steady one-dimensional Navier-Stokes equations is presented for the case of Prandtl number equal to three quarters and constant coefficients of specific heats and viscosity. It has been shown both theoretically and experimentally that the solution is valid for

ordinary air flows with free-stream Mach numbers not exceeding about two. The unsteady flow solution is achieved by assuming a small perturbation of the steady flow and thence linearizing the equations. It is further assumed that the disturbance grows exponentially with time. An explicit set of two linear homogeneous ordinary differential equations for the velocity and temperature disturbances as functions of the space variable, with the complex damping or amplification factor as an eigenvalue depending on the disturbance wave length, is then derived. Disturbed uniform flows of both inviscid and viscous fluids are solved exactly; the resulting characteristic equations have eigenvalues with negative real parts which indicate that the disturbance decreases with time and hence that the uniform flows are stable. These results can be interpreted as indicating the speed of propagation and the rate of damping of one-dimensional sound waves. Approximate methods must be applied to obtain the characteristic equation for shock-wave flows. All of several methods used here, which are essentially first-approximation methods based on collocation and on Galerkin's method, yield the exact solution results for the special case of sonic flows, and all tend to predict instability for shock-wave flows. The analysis indicates, in particular, that at least for supersonic Mach numbers below about three there will always exist disturbance wave lengths, namely sufficiently large ones, for which the disturbances will tend to amplify with time. The instability is less pronounced, if at all present, for very small wave lengths. The instability of the shock-wave flow solution may be associated with the instability of standing normal shock waves in parallel channels.

Microfilm \$2.00; Xerox \$4.00. 73 pages.

## ENGINEERING, CHEMICAL

### HEAT TRANSFER PROPERTIES OF A PACKED BED: DETERMINATION BY A FREQUENCY RESPONSE TECHNIQUE

(L. C. Card No. Mic 58-3793)

William Ernest Ball, Sc.D.  
Washington University, 1958

Chairman: W. P. Armstrong

A general partial differential equation for the temperature distribution in a packed bed, with axial flow of fluid, was derived. Solutions, subject to the boundary conditions of constant wall temperature and sinusoidal variation in the inlet fluid temperature, were obtained for the cases of axial thermal diffusion being either negligible or significant. Simplified forms of the exact analytical temperature distribution equations were derived which were applicable to the analysis of experimental frequency response data.

The frequency response of a six inch diameter bed packed with 1/8 inch diameter Tabular Alumina spheres was obtained as a function of packing depth up to a maximum bed depth of 25 inches. Three frequencies (13.86, 24.64 and 58.00 radians per hour) at each of the three air flow rates (240, 328 and 409 lb<sub>m</sub>/hr ft<sup>2</sup>) were used.

Values for the individual particle-to-air film coefficients and the effective radial thermal conductivity, as determined by the frequency response technique, were in good agreement with similar values from the literature. Values for the effective axial thermal conductivity were also determined and found to be approximately ten times the value for the corresponding effective radial thermal conductivity.

It was concluded that the frequency response technique was a reliable method for simultaneously obtaining experimental values of the film coefficient, wall coefficient and radial and axial thermal conductivities for a packed bed system. Microfilm \$2.00; Xerox \$6.60. 137 pages.

### THE EFFECTS OF GAMMA RADIATION ON SEVERAL POLYSULFONE REACTIONS

(L. C. Card No. Mic 58-3641)

Bruce Glenn Bray, Ph.D.  
University of Michigan, 1958

The purpose of this work was to study the effects of gamma radiation from cobalt-60 on the copolymerization reactions of sulfur dioxide with various hydrocarbons. Ethylene, propylene, butene-1, butene-2, isobutylene, hexene-1, decene-1, dodecene-1, 1-3 butadiene, and cyclopropane were the hydrocarbons used. One portion of the work involved a study of the effects of the radiation on some of the properties of the copolymer reaction products. The second portion of the work involved a study of the kinetics of the reactions in a radiation field.

The majority of the reactions were conducted in small batch reactors at a temperature of 0°C, at radiation intensities of 40 to 65 kilorep per hour, and with approximately equimolar proportions of hydrocarbon to sulfur dioxide. Reaction times and radiation doses were varied for each of the reactions.

In the case of the hexene-1, sulfur dioxide reaction, the temperature was varied from -77.3 to +46.3°C, the radiation intensity was varied from 3.58 to 987 kilorep per hour, and the initial proportion of hexene-1 to sulfur dioxide was varied from .187 to 5.69 in order to determine the effect of these variables on the reaction.

Melting or decomposition points, densities, and tensile strengths of the copolymers were somewhat higher than the corresponding values reported for the copolymers produced by other means. The values of these properties decreased with increasing molecular weight of the hydrocarbon reactant. Sulfur contents and solubilities in ordinary solvents of the copolymers were generally the same as reported in the literature. Sulfur analyses showed that equimolar amounts of hydrocarbon and sulfur dioxide combined in the reactions. The copolymers from high molecular weight hydrocarbons were soluble in non-polar solvents while those from low molecular weight hydrocarbons were soluble in polar solvents. Estimated molecular weights from solution viscosity measurements were larger than previously reported.

Correlations of the kinetic data were obtained from expressions derived from a free radical type reaction. According to this mechanism the reactions start by free radical initiation in the radiation field. This is followed

by alternate addition of the reactant monomers, and by radical termination. The correlation and the mechanism agree with those presented previously for similar reactions under different initiation conditions.

In the case of the hexene-1, sulfur dioxide reaction, the rate was found to be proportional to the radiation intensity to the .76 power, and to the concentration of each reactant to the first power at the high sulfur dioxide concentrations. At the lower temperatures the logarithm of the reaction rate constant varied linearly with the reciprocal of the absolute temperature. Near the "ceiling temperature" of 57° (above which the reaction does not occur) and at high hydrocarbon concentrations the rate varied more irregularly with intensity, concentration, and temperature.

Microfilm \$2.55; Xerox \$8.80. 193 pages.

### THE EVAPORATION OF BRINE SOLUTIONS IN A FLUIDIZED SALT BED

(L. C. Card No. Mic 58-2841)

Joseph Foster Frantz, Ph.D.  
Louisiana State University, 1958

Supervisor: Professor Bernard S. Pressburg

The mining of sulphur by the Frasch Process requires from 4 to 50 tons of superheated water for each ton of sulphur mined. The water is heated by direct steam injection to 325°F and pumped down a well into an underground sulphur dome where its sensible heat is utilized in the melting of the sulphur. Compressed air enters the base of the well and aerates the sulphur causing it to flow to the earth's surface.

Before it can be used as boiler feed water for the production of steam to heat the mine water, the water supply requires chemical treatment to remove scale forming salts or to inhibit their scale-forming action; otherwise a scale forms on boiler tubes and reduces the capacity of the boilers. When the sulphur domes are offshore, the problem of providing boiler water is most serious due to the high (3.5%) solids content of sea water. Although the sodium chloride (constituting 3.0% by weight of the sea water) does not form scale, the other salts are primarily scale-forming compounds which readily adhere to boiler tubes. Conventional chemical treatment of sea water is economically prohibitive because of the large quantities of solutes, absolute as well as compared to onshore water supplies, and the correspondingly high quantities of treating agents required. However, since the use of untreated sea water for the production of 80 psig steam, as required by the usual process, causes a rapid deposition of scale and subsequent shutdown for cleaning every few hours, a solution to this problem must be found; the only alternative used at present is to transport boiler water from onshore sources, a practice which is both uneconomical and troublesome due to the tremendous quantities involved.

This research investigated the feasibility of evaporating dilute salt solutions in hot fluidized salt beds, a proposal which if proven satisfactory would utilize sea water as a source of boiler water and would circumvent the scale problem.

Owing to the limited data available on the fluidization

of salt, preliminary work was carried out to determine the fluidization quality of salt. Encouraging results were obtained at this point and the evaporation process and variables affecting its operation were then examined.

It was found that dilute salt solutions can be evaporated in hot fluidized salt beds with evaporation rates as high as 140 pounds of solution per hour per square foot of tower cross section. Rates twice as high as this may be possible in well insulated commercial units operating at higher gas rates than those studied in the laboratory. The experimental rates correspond to operation with steady-state salt bed temperatures in the range of 270 to 660°F; however, no absolute minimum or maximum operable bed temperature was determined. Fluidizing gas velocities approximately twice the minimum fluidization velocity were required for proper circulation and mixing of the fluidized solid particles and to prevent stagnant areas in the bed during the evaporation process. Optimum average particle size for the fluidization of salt was determined to be in the range of 150 to 300 microns. Particles below 150 microns caused severe balling and agglomeration and particles larger than 300 microns gave poor fluidization. Experimental results were interpreted to explain theoretically the mechanism of the evaporation process.

Microfilm \$2.00; Xerox \$4.60. 86 pages.

### A KINETIC STUDY OF THE ESTERIFICATION OF GLYCEROL WITH STEARIC, OLEIC AND LINOLEIC ACIDS

(L. C. Card No. Mic 58-3666)

Richard Byrd Graver, Ph.D.  
University of Michigan, 1958

An investigation has been made of the kinetics of the esterification of glycerol with stearic, oleic and linoleic acids. The variables considered were temperature and initial concentration of the reactants.

The investigation involved purifying the acids as well as studying the esterification reactions. The purification was accomplished by fractional crystallization of the acids from a suitable solvent. Pure stearic and oleic acids were obtained by this technique; however, only 95% pure linoleic acid could be obtained.

The esterification reactions were studied by measuring the change in acid concentration during the course of the reaction. The results of this study may be summarized as follows:

1. The mechanism of esterification reaction appears to be the same for each of the acids and the following general equation was developed to express the rate of the reaction as a function of the acid and glycerol concentration:

$$-\frac{d(a-x)}{dt} = \frac{dx}{dt} = k\left(\frac{1}{b}\right)^{\gamma} \left((a-x)(b-x)\right)^{\alpha}$$

where a and b are the initial concentrations of acid and glycerol respectively in equivalents/100 gm, x is the amount of acid or glycerol reacted and k,  $\alpha$  and  $\gamma$  are constants.

2. The exponential constant,  $\alpha$ , was found to lie between 1.12 and 1.23 with the average value being 1.18.

3. It appeared that the value of the exponential constant,  $\gamma$ , was between 0.64 and 1.2, but its value was not critical. That is, any selected value of  $\gamma$ , would only change slightly the value of the rate constant,  $k$ , of the reactions.
4. The rate constant,  $k$ , obeyed the classical Arrhenius Equation  $-E_o/RT$   

$$k = Ae$$
 very well as long  $\gamma$  was between 0.64 and 1.2. For this reason it appears best to use  $\gamma = 1.0$  in order to simplify calculations.
5. The reaction rate constants were highest for linoleic acid and lowest for stearic acid in the temperature range studied (190-240°C). But the difference between the rate constants was not large enough to be considered very significant.
6. Since the reaction rate appears to be inversely proportional to the initial glycerol concentration the products may be inhibiting the reaction. However no data was taken on the composition of the mono-glycerides, diglycerides and triglycerides during the course of the reaction because of the limited amount of pure acids available which prevented the use of batches large enough for such analyses.
7. From data obtained no reaction mechanism can be predicted but it is evident that the reaction is complex in nature.

The above rate equation can be used to correlate similar esterification data which has been published. In addition this equation is suitable for use in future reactor design. Microfilm \$2.00; Xerox \$6.60. 138 pages.

#### UTILIZATION OF GYPSUM IN THE MANUFACTURE OF FUSED PHOSPHATE FERTILIZER

(L. C. Card No. Mic 58-3003)

Maurice Allen Larson, Ph.D.  
Iowa State College, 1958

Supervisor: D. R. Boylan

An investigation was undertaken to determine if gypsum could be used as an addition agent in a fusion process for the manufacture of phosphatic fertilizer.

A small laboratory furnace was constructed of insulating firebrick for the fusion of various mixtures of phosphate rock and gypsum. After fusion, the melts were quenched in a water spray. The resulting product was dried, ground and analyzed.

The most favorable fused product resulted from the fusion and subsequent quenching of a mixture containing 7 parts dehydrated gypsum and 3 parts phosphate rock. This product contained 10.5 per cent total  $P_2O_5$ , 10.4 per cent  $P_2O_5$  soluble in 2 per cent citric acid, 33.0 per cent  $SO_3$  and 1.13 per cent fluorine. It was basic in character, white in color, nonhygroscopic and easily ground. The product was subsequently leached with water and the resulting solid material contained 14.1 per cent  $P_2O_5$  soluble in 2 per cent citric acid. No loss of  $P_2O_5$  occurred during leaching.

It was found that the addition of certain other materials, namely, glaserite, langbeinite, KCl and  $K_2SO_4$ , with the

gypsum had no beneficial effect on the product obtained. However, it was found that  $MgSO_4$  was beneficial and that if  $MgSO_4$  was used without addition of gypsum a product containing 21 per cent soluble  $P_2O_5$  could be obtained.

As a result of the promising laboratory studies, a pilot plant was constructed and operated at a rate of 75 pounds per hour. The fusion furnace was a horizontal gas fired furnace lined with an alumina-silica refractory having a pyrometric cone equivalent of 31. Corrosion of the refractory was controlled by cooling the hearth shell with a stream of water. It was found that chrome refractories were no more satisfactory in regard to corrosion than were the ordinary fire clay refractories. The furnace was operated at a temperature range of 2400 to 2500°F. which produced a very fluid molten product. The quenched product was white in color, chalky in appearance, and granular. It contained 11 per cent citric acid soluble  $P_2O_5$  and 11.6 per cent total  $P_2O_5$ .

A fixed capital cost was made which indicated that a plant producing 200 tons per day of either 0-11-0 or 0-9-0 fertilizer could be constructed for approximately \$400,000. The working capital investment was estimated to be \$100,000. It was also estimated that the 0-11-0 product could be produced, using mineral gypsum, for \$13.70 at a plant located in Fort Dodge, Iowa. The 0-9-0 product was estimated to cost \$10.10 per ton at Joplin, Missouri using by-product gypsum at no cost. Assuming a selling price of \$1.36 per unit of  $P_2O_5$ , a return on total investment of 8.35 per cent could be expected on the 0-9-0 plant and a return of 2.85 per cent could be expected on the 0-11-0 plant.

X-ray diffraction analysis of the product indicated a slightly expanded apatite structure together with the anhydrite structure. It is suggested that the solubility of the  $P_2O_5$  in the product resulted from the bond weakening effect of a dissolution of calcium sulfate in the apatite structure and a substitution of  $SO_4$  groups for  $PO_4$  groups in the apatite lattice. The resulting soluble phosphate containing phase is proposed to be  $Ca_{10}F_2(PO_4)_6 \cdot 6CaSO_4 \cdot xCaO$  where  $x$  is equal to or less than nine.

Microfilm \$2.00; Xerox \$6.20. 128 pages.

#### CONTINUOUS MASS DIFFUSION IN A NATURAL CONVECTION COLUMN

(L. C. Card No. Mic 58-3709)

Richard Schwaab Mayer, Ph.D.  
University of Michigan, 1958

The binary gas systems of helium-methane, helium-oxygen and oxygen-nitrogen (air) were effectively separated in a natural convection, mass diffusion column. The column was designed for continuous stripping operation at atmospheric pressure, employing steam as the separating vapor. Gas feed rates up to 14.6 c.f.h. and vapor rates up to 16 lbs./hr. were used. The ratios of top to bottom products withdrawal rates were 1.0 and 2.1, with the condenser water temperature ranging from 25°C to 75°C.

The column consisted of a nine foot, 1 1/2" o.d. porous, bronze tube for vapor distribution, and its surrounding condenser. The annular spacing was 1/2". The feed gas was introduced into the annular separating zone by means of a circular distributor cap at the top of the column. The

top product stream was withdrawn by means of this same cap, while the bottom product and vapor condensate were removed from the bottom of the annulus. Superheated steam from an electrically heated boiler entered the porous tube at its bottom end at pressures up to 1 p.s.i. and temperatures up to 175°C. The gas handling was by means of motor-driven gasometers, and the gases were analyzed by a thermal conductivity cell and Orsat apparatus.

Equations were derived to calculate the gas separation that could be expected from straightforward mass diffusion and the concurrent thermal diffusion effect, as evaluated in terms of the predicted convection currents within the column. The experimentally observed gas separations were too great to be explained solely on the basis of these equations.

Pressure drop measurements across the wall of the porous vapor-tube, and visual observations of the operation of an auxiliary, three foot column with a glass condenser, indicated that the porosity varied considerably along the length of the vapor-tube. Additional equations were derived to show how: 1) The back-diffusion of the gases into the vapor-tube and their subsequent readmission to the annular space could improve the separating effect of the column, and 2) how the varying of the convection currents along the length of the column could effect the column's separation and the partial pressure of the vapor in the annulus. Inability to evaluate the vapor-tube's porosity prohibited quantitative calculations of these two effects, but evaluation of a pseudo over-all transport coefficient indicated that greater separations were present inside the column than were shown by the exit products.

The relative diffusivities of the steam-helium-oxygen and steam-helium-methane systems are nearly identical, so the greater separations when oxygen was present were attributed to its greater molecular weight which produced higher convection velocities. The air separations proved oxygen more diffusible than nitrogen with regards to steam, and the top product was oxygen enriched. The short, glass condenser column produced only small separations, but indicated that separations could be produced by a longitudinal partial pressure gradient of the vapor.

Recommendations are given for improvement in the method of column operation and the manner in which future experimental research should be conducted.

Microfilm \$2.00; Xerox \$6.80. 145 pages.

#### INVESTIGATION OF THE NICKEL-CADMIUM CELL

(L. C. Card No. Mic 58-2880)

Alvin J. Salkind, D.Ch.E.  
Polytechnic Institute of Brooklyn, 1958

Adviser: Paul F. Bruins

The purpose of this investigation was to determine the reactions and the kinetics of the Nickel-Cadmium cells and to develop a separator material which would be unaffected by the presence of copper impurities in the cell electrodes.

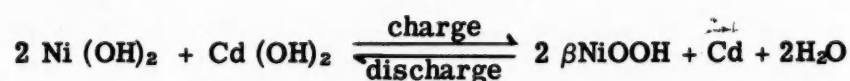
The solid reaction products of the Nickel and Cadmium electrodes were studied by X-ray techniques. Special

equipment and techniques were developed which permitted X-ray films and diffractometer patterns to be obtained from the electrodes, wet with alkali, while in service, and in any state of charge or discharge. Open circuit voltage decay measurements were obtained at temperatures between 0°F and 125°F for the cell electrodes with specially constructed Mercury-Mercuric Oxide reference electrodes. The effects of plate spacing, electrolyte concentration, and separator materials on cell performance and charge retention were determined by constructing cells of the "Sandia" type. These cells had a nominal capacity of five ampere-hours.

The initial voltage decay of both the cadmium and nickel electrodes was linear with the logarithm of time. The voltages of the Cadmium electrodes stabilized at  $-0.88 \pm .01$  volts with respect to hydrogen, after a few days, over the entire temperature range tested. The nickel electrodes however, entered a second decay period, four or five days after the end of charge. The rate of voltage decay in this period was much slower than in the initial period and the voltages were also linear with the logarithm of time. The voltage of nickel electrodes in both periods was a function of the storage temperature. A curve relating the rate of voltage decay with temperature was obtained.

The mechanisms of shorting caused by copper in the plates of cells with cellulosic separators and in cells with microporous separators were determined. Microporous ion-exchange separators were developed which were capable of retarding the shorting of cells caused by copper impurities in the electrodes. Cells with "Polypor" separators have improved low temperature discharge characteristics and high rate discharge characteristics in comparison to cells with standard cellulosic separators.

The overall reaction in the Nickel-Cadmium cell was found to be



Potentials of cells were increased by changing from 31% KOH electrolyte to 20% KOH, mainly because of the increased activity of water. The nickel electrode had a negative coefficient of voltage change with temperature. This effect was much greater than that observed with the cadmium electrode and determined the overall effect of temperature upon cell voltage.

The Heat of Reaction for the cell was calculated from the slope of a plot of  $E/T$  versus the logarithm of the vapor pressure of water, and was found to be - 62 Kcal. per gm. mole.

Microfilm \$2.25; Xerox \$7.80. 170 pages.

# EFFECT OF TURBULENCE INTENSITY ON MASS TRANSFER FROM PLATES, CYLINDERS, AND SPHERES IN AIR STREAMS

(L. C. Card No. Mic 58-3058)

John Adelbert Schnautz, Ph.D.  
Oregon State College, 1958

Major Professor: Charles E. Wicks

The effect of turbulence intensity on mass transfer rates along flat plates parallel to flow, around circular cylinders normal to flow, and around spheres is presented. Both local and mean data are presented for the models.

Transfer coefficients expressed as dimensionless mass transfer Nusselt numbers were calculated from data obtained from sublimation of naphthalene models. The models were roughly cast and then machined to  $\pm 0.001$ -inch tolerances. Measurement of sublimation rates were made with a dial indicator.

Previous workers have conducted limited studies of heat and mass as affected by turbulence intensity; however, this study makes use of improved techniques which reduce data scatter and covers a greater range of Reynolds numbers than any previous study. Data for Reynolds numbers from 1000 to 1,000,000 were obtained. Six turbulence levels between 0.5 per cent and 11.0 per cent were studied.

The local flat plate data contained end effects which resulted first in an increased transfer rate and then a decrease along the surface. No transition between laminar and turbulent flow was evident. For plates at Reynolds numbers above 500,000, a rippling became noticeable in the latter half of the plate, possibly due to a damping of the previously discussed end effects.

The distribution of mass transfer rates around cylinders showed maximums at both points of stagnation and at about 110 degrees on either side of the forward stagnation point. Minimums were evident at about 85 and 135 degrees from the forward point. These values varied somewhat for the different Reynolds numbers and turbulence levels. This shape of curve might only be expected at Reynolds numbers above the critical; however, it was evident even at lowest Reynolds numbers. It is hypothesized that the double maximum data are affected by the ratio of molecular diffusivity to diameter of model. A study of ratio of thermal conductivity of fluid to diameter of model in heat transfer is used to substantiate this hypothesis. Another factor which might have caused the development of this phenomenon is the surface roughness which is considerably greater than that of similar polished models used for heat transfer studies. A third possible cause is the effect of change of shape of model resulting from the variation of sublimation rates around the cylinders. Although this was small, it could have had an effect of changing the flow pattern around the model.

Similarly shaped curves were obtained for spheres with the notable exceptions that the sphere data had consistently higher transfer rates than cylinders and the rear area of the spheres was proportionately higher than that area for cylinders at comparable Reynolds numbers and turbulence levels.

Mean transfer data in the form of Colburn's  $j_M$ 's were correlated with Reynolds number and turbulence intensity. The derived equations for plates, cylinders, and spheres follow respectively.

$$\log j_M = -1.28 + 0.0168 I - 0.222 \log N_{Re}$$

$$30,000 < N_{Re} < 1,000,000$$

$$0.5 < I < 7.4$$

$$\log j_M = -0.562 + 0.0168 I - 0.404 \log N_{Re}$$

$$1,000 < N_{Re} < 200,000$$

$$0.5 < I < 11.0$$

$$\log j_M = -0.104 + 0.0179 I - 0.478 \log N_{Re}$$

$$1,000 < N_{Re} < 100,000$$

$$0.5 < I < 9.4$$

These correlations are compared to other existing data. Good results are indicated for both heat and mass transfer. Microfilm \$3.35; Xerox \$11.40. 258 pages.

# SULFOCHLORINATION OF HYDROCARBONS INDUCED BY GAMMA RADIATION

(L. C. Card No. Mic 58-2884)

Alfred Schneider, D.Ch.E.  
Polytechnic Institute of Brooklyn, 1958

Adviser: Ju-Chin Chu

The purpose of this study was to determine the effect of gamma radiation on the direct sulfochlorination of hydrocarbons and nitrobenzene.

The radiation source consisted of spent uranium fuel elements, providing a gamma radiation intensity up to  $2.5 \times 10^6$  roentgen/hour. The sulfochlorination studies were carried out either with  $SO_2Cl_2$  or with gaseous mixtures of  $SO_2$  and  $Cl_2$ . Attempts to sulfochlorinate nitrobenzene and benzene were unsuccessful. There was no detectable reaction in the case of nitrobenzene, while the reaction with benzene produced only chlorinated products, up to the full addition product 1,2,3,4,5,6-hexachlorocyclohexane.

Liquid cyclohexane reacted with  $SO_2$  and  $Cl_2$  in the presence of gamma radiation to give very high yields of cyclohexanesulfonyl chloride, and to a smaller extent chlorocyclohexane and cyclohexanedisulfonyl chloride. The length of the chemical chain reaction induced by gamma radiation was estimated at over  $2 \times 10^5$ , and the radiochemical yield  $G$  was greater than  $10^6$ . Sulfochlorination was the predominant reaction, but at lower radiation intensities and for  $SO_2/Cl_2$  ratios lower than unity, chlorination was found to exceed sulfochlorination. Within a temperature range of 11.5 to 40.0°C, the selectivity of the reaction was independent of temperature. For a total gas flow rate of 1.9 l/min per liter  $C_6H_{12}$  and  $SO_2/Cl_2$  ratios of 2/1, the rate of conversion to  $C_6H_{11}SO_2Cl$  was proportional to the square root of the absorbed radiation dose up to a dose rate of 40 rad/min, but became independent of dose rate above 400 rad/min. Under these conditions, the conversion rate was 0.025 g-moles  $C_6H_{11}SO_2Cl$ / (l) (min). A basic plant design was developed for the continuous sulfochlorination of cyclohexane initiated by gamma radiation. The economics of this process may become attractive with the expected availability of cheap radiation sources.

Solutions of cyclohexane, chlorine and sulfur dioxide in carbon tetrachloride were irradiated in an oxygen-free system. Reaction rates, equivalent to the rate of disappearance of free chlorine, were determined spectrophotometrically at 4000 Å. The reaction products were

cyclohexanesulfonyl chloride and hydrochloric acid in nearly stoichiometric quantities. An empirical rate equation was derived, in which the rate of disappearance of chlorine was shown to be proportional to the square root of the product of absorbed radiation, chlorine and cyclohexane concentrations, and independent of the concentration of sulfur dioxide. A chain mechanism was proposed, and the rate equation derived from this scheme was found to be in excellent agreement with the empirical rate equation. The reaction proceeded by a free radical mechanism, as evidenced by the strong inhibiting effect of oxygen. G-numbers were of the order of  $10^5$ , corresponding to an estimated chain length of 5000, which is of the same order as the quantum yield of the photochemical sulfochlorination. Activation energies for the individual reactions were derived from the reaction rate constants at two temperatures and compared favorably with values reported for similar photochemical reactions.

Microfilm \$2.00; Xerox \$6.80. 142 pages.

#### PRELIMINARY SINTERING PHENOMENA IN ALUMINUM OXIDE

(L. C. Card No. Mic 58-3023)

David Randolph Wilder, Ph.D.  
Iowa State College, 1958

Supervisor: Morton Smutz

The preliminary sintering characteristics which occur in fine aluminum oxide powders were studied in the temperature range of 25° C. to 1200° C. The aluminum oxides considered were all in the high temperature form, the alpha or corundum structure as is commonly utilized for super refractories. Three of the aluminum oxides investigated were manufactured by calcination of aluminum hydroxide from the Bayer process. One of the materials investigated was produced by arc fusion of bauxite. The latter material was studied with respect to particle size, the former three materials were studied in the as received, ball milled particle size distributions. Nitrogen adsorption and microscopic measurements were employed to determine the particle size distributions.

Changes in the surface adsorbed ions were investigated by water slaking characteristics, thermogravimetric analysis, and infrared spectroscopy. The changes consist of a reversible loss of water and hydroxyl groups. This loss is temperature dependent and varies widely for the various materials considered.

The nature of the sintering phenomena was observed in the temperature range 1000° C. to 1200° C. where macro shrinkage becomes apparent. Sintering rates increase with decreasing particle size. The initiation of sintering occurs after, but not necessarily immediately after, the loss of surface adsorbed ions mentioned in the paragraph above. The mechanisms by which sintering progresses, i.e., material transport phenomena, were found to be complex in nature. They are not describable by an Arrhenius equation, nor fully defined by any one of the possible mechanisms: plastic flow, evaporation and condensation, surface diffusion, and volume diffusion. A combination of the first

of these mechanisms and one or more of the remaining could describe the phenomena observed.

Microfilm \$2.00; Xerox \$5.80. 118 pages.

#### ENGINEERING, CIVIL

##### ROTATION CAPACITY REQUIREMENTS FOR BEAMS AND FRAMES OF STRUCTURAL STEEL

(L. C. Card No. Mic 58-3073)

George C. Driscoll, Jr., Ph.D.  
Lehigh University, 1958

Plastic analysis of steel structures depends on the ability of the members to form plastic hinges and to redistribute moments. In order for redistribution of moment to take place, certain plastic hinges must sustain their plastic moment through some angle of rotation. The amount of rotation required may affect the stability of the structure and, therefore, may affect the geometry of the structural shapes selected and the spacing of lateral bracing. The ability of a structural member to rotate the required amount in order to redistribute the necessary moments and form a mechanism is defined as the "rotation capacity." The angle of rotation during which a yielded segment of beam must sustain its plastic moment value is termed the "hinge angle."

This dissertation deals with a method of calculating the approximate hinge angle through which a member must be able to rotate to form a mechanism. The method of solution is based on the assumption that the complete bending moment diagram for a structure can be obtained from a routine plastic analysis. The method is based on the further assumption that, when a structure has reached ultimate load and formed a mechanism, the length of the yielded zones at each plastic hinge is zero. This makes it possible to calculate rotations, slopes and deflections by methods of the theory of elasticity, accounting for the plastic hinges simply by changing the boundary conditions to allow for the necessary freedom to rotate. In this dissertation, the method used to calculate rotations, slopes, and deflections is an adaptation of the classical elastic slope-deflection method.

The problem of calculating the required rotation capacity of a structure is examined in three steps:

- 1) Calculation of the ultimate load and ultimate moment diagram.
- 2) Location of the first and last plastic hinges to be formed in the structure.
- 3) Calculation of deflection and rotation by using the slope-deflection equations and considering boundary conditions appropriate for a structure in the plastic range.

The study is aimed at the determination of the rotation capacity of multi-span gabled frames. However, the theory is developed in simple stages and covers a three-span continuous beam and single-span portal frames as the basic steps in the method are illustrated. The new work of the

dissertation is primarily concerned with steps (2) and (3) of the above method. Multi-span frames are solved by separating the frames into single span elements called subassemblages. Then the results of the rotation calculations for single-span frames are used to advantage. Special treatment is given to finding the location of the last plastic hinge in multi-span frames. In treating this problem, the concept of a self-supporting subassemblage containing the last plastic hinge and non-self-supporting subassemblages, which rely on adjacent spans for part of their support, is introduced. An interesting discovery in the study of multi-span gabled frames was that it was possible, under certain cases of loading, to form mechanisms in which the roof deflects upwards causing negative work to be done by the roof loads.

Using the results of the theoretical studies, some typical structures are designed as illustrations and their required rotation capacity is compared with the actual rotation measured in some experimental tests.

Microfilm \$3.10; Xerox \$10.60. 238 pages.

#### THE EVALUATION OF THE REFRACTION ANGLES IN GEODETIC MEASUREMENTS FROM TWO OBSERVATION STATIONS

(L. C. Card No. Mic 58-3689)

Samuel A. Kisso, Ph.D.  
University of Michigan, 1958

The purpose of this investigation is to determine the refraction angles in geodetic measurements without measuring and using pressure, temperature, and lapse rate of temperature in computation. The importance of this determination arises from the facts of difficulties of determining the exact values of the meteorological factors along the path of a ray of light, and the small uncertainty in lapse rate of temperature and its high effect on the computed refraction angles.

The method of analysis is based upon having two paths of sight travel close to each other so that the meteorological factors can be assumed equal along the two paths. This is done by observing one point from two observation stations. They are located in such a way that the paths of sight from the stations to the point have nearly the same azimuths and the distance between the stations is such as to provide an appreciable discrepancy between the apparent heights of the observed point.

Formulas for computations are presented, and the probable errors are discussed. Tests of actual measurements are made to prove the applicability of the method, and a comparison between the new and the old methods is provided. The results are satisfactory and of relatively high accuracy. For example, the percentage of the errors of three observations that are determined by adopting the new method is 2.6 per cent, whereas the percentage of the errors that are determined by adopting the old method for the same observations is 20.5 per cent.

The conclusion which can be drawn from the investigation is, that the refraction angles can be determined with adequate accuracy and without facing the difficulties of determining the exact values of the meteorological factors; hence the method can be used in establishing bench marks

in regions that can not be reached, or which are very difficult to reach by lines of spirit leveling.

Microfilm \$2.00; Xerox \$3.60. 64 pages.

#### ENGINEERING, ELECTRICAL

##### EDDY CURRENT LOSSES IN SOLID AND LAMINATED IRON

(L. C. Card No. Mic 58-2863)

Paul Dharam Agarwal, D.E.E.  
Polytechnic Institute of Brooklyn, 1958

Adviser: John G. Truxal

In this thesis there are developed, on the basis of simple physical conceptions, formulas for the calculation of eddy currents in solid and laminated iron, which, as the experiments presented show, enable the losses caused by eddy currents to be predicted with surprising accuracy. A simple formula for the calculation of the power factor that the magnetic circuit reflects into the magnetizing winding is also presented.

The theory employed in developing the formulas assumes that the permeability of steel is infinite for all flux densities below a limiting saturation value,  $B_0$ , and zero above that, giving a rectangular magnetization curve. Solution of Maxwell's Equations, when a sinusoidal mmf is impressed on a core composed of steel plates, and under the conditions of this ideal B-H curve, yields, that a wave of flux density  $B_0$ , enters each plate from the outside surface at the start of each half cycle, and penetrates to a depth  $\delta$ , the "depth of penetration." Depth of penetration is the extreme depth to which fields penetrate, and is derived analytically. If  $\delta$  is less than  $d$ , the half thickness of plate, the inner part of the plate remains unmagnetized, and the magnetic flux as well as the eddy currents are confined to a layer of depth  $\delta$ , on each surface of the plate. If  $\delta$  is greater than  $d$ , the flux density waves from the two sides meet in the center of the plate before the end of each half cycle, and for the remainder of the half cycle the plate remains magnetized to the value  $B_0$ . In this case, therefore, the eddy currents flow during the first portion of each half cycle and are zero during the period the plate is fully magnetized. Wave shapes of voltages induced in the search coils, placed around the specimens, substantiate this experimentally.

The eddy current loss and the power factor of the magnetic circuit are calculated by the Poynting Vector Theorem. Since the applied mmf is sinusoidal, only the fundamental of the electric field contributes to power flow into the iron. Eddy current loss formulas when the impressed flux is sinusoidal and using the same theory is also presented.

Actually, the B-H curve of steel departs materially from the assumed rectangular shape. Also, both the applied mmf and flux wave may depart materially from pure sine waves. These and other factors can be taken into account empirically. The value of  $B_0$  to be used in the formulas has been determined empirically to be  $3/4 B_m$ , where

$B_m$  is the flux density obtained from the static magnetization curve of the material corresponding to  $H_m$ , the peak of the impressed mmf. With this value of  $B_o$ , the formula gives the eddy current losses with satisfactory accuracy over the entire range of tests performed.

Tests were made over a wide range of variables, plate thickness - 0.025 to one inch, frequency - from 15 to 2000 cycles per second, and applied magnetomotive force - from 25 to 450 ampere turns per inch. The calculated and measured values of eddy current losses are within about 15 percent of each other over the entire range of the tests. In different samples from the same material, the value of  $H$  for the same  $B$  may vary within  $\pm 12$  to 15 percent, and hence an error of this order is expected in estimating these losses. Microfilm \$2.15; Xerox \$7.60. 163 pages.

**NETWORK REALIZABILITY THEORY AND  
ITS APPLICATION TO THE SYNTHESIS OF  
DISTRIBUTED PARAMETER MATCHING  
NETWORKS**

(L. C. Card No. Mic 58-2864)

Liborio J. Castriota, D.E.E.  
Polytechnic Institute of Brooklyn, 1958

Adviser: Herbert J. Carlin

A general theory of network realizability for linear, passive, time-invariant networks is presented from the point of view of energy conservation and causality. It is shown that four postulates defining the physical nature of a network suffice to give all the analytic properties of the network scattering matrix. These analytic properties define a bounded real scattering matrix, the possession of which is necessary and sufficient for an  $n$ -port network to satisfy physical realizability as stated by the given set of postulates. A theorem concerning the necessary and sufficient conditions for the existence of a Faltung-representation is proved and its implications discussed.

For a physically realizable one-port immittance, when the function is meromorphic and of exponential type, it has been shown that its representation in terms of a lossless two-port terminated in a pure resistance always exists. This is a generalized version of the Darlington theorem.

The problem of the broadband matching of an arbitrary one-port immittance is also considered as an application of the theoretical material. The theoretical limitations of the load are transformed into a set of generalized integral restrictions. The restrictions are derived on the basis of half-plane representation theory and are applicable to a broad class of functions.

The approximation of a distributed parameter one-port immittance in terms of commensurate lossless transmission lines and resistors is also taken up. The techniques by which the approximation results includes a rational function approximation in the domain of a transformed plane utilizing potential analogue computer methods and direct interpolatory procedure. An alternate method is the stepwise approximation of a scattering distribution function when a Faltung-representation exists and the distribution function is a monotonic non-decreasing function of bounded variation. When such is the case it is shown

that an estimate on the upper bound of the error in the approximation may be determined where the error may be made as small as is required.

Consideration is also given to a technique for the broadband matching of a distributed parameter load described in terms of lambda functions, where the matching structure consists of a cascade of lossless commensurate transmission lines with at most transmission line elements interposed between them. Bi-linear and quadratic lambda function load impedances serve as illustrative examples.

Microfilm \$2.55; Xerox \$8.80. 194 pages.

**MAGNETIC AMPLIFIERS WITH  
D-C COUNTER E. M. F. LOADS**

(L. C. Card No. Mic 58-2871)

Enrico Levi, D.E.E.  
Polytechnic Institute of Brooklyn, 1958

Adviser: Edward J. Smith

The recent development of high quality magnetic and semiconductor materials has greatly improved the gain and efficiency of magnetic amplifiers, thereby widening the range of power for which they constitute the best available amplifier.

One typical field of application is automatic speed control, where magnetic amplifiers combined with a D-C Machine provide an efficient, stable, rugged and reliable drive which can be connected directly to a standard a-c supply.

The performance of a magnetic amplifier is affected by the presence in the load circuit of an active element such as the armature of a D-C motor or an electrolytic cell.

This dissertation deals with the analysis and synthesis of magnetic amplifiers whose load circuit includes a source of D-C counter e.m.f. The case considered being the most general, the method of attack and the results apply to all other kinds of loads.

The combination of elements, whose characteristics are non linear, asymmetric, multivalued and sometimes unpredictable, accounts for the many difficulties presented by this problem.

In order to separate counteracting and sometimes balancing effects, a step by step procedure is followed starting from the simplest half-wave circuit, idealized characteristics of cores and rectifiers, limiting values of circuit parameters.

Subsequent approximations to the actual characteristics are critically chosen, to achieve good agreement with experimental results, without loss of simplicity in the analytical expressions.

Maximum advantage is taken of the integral or average character of most of the relevant quantities, by using the available technique of volt-time areas, which gives much insight into the operation of the amplifier and allows for graphical calculations.

When considering the transient behaviour, the complexity and the non linearity of the equations involved limits the use of difference equations and block diagram techniques as computational tools.

A clear understanding, however, of the mechanism of reverse transmission from output to input and its effect on

gain and speed of response is a prerequisite to the analysis.

Effective decoupling of the amplifier from its output circuit cannot be achieved when the load contains a source of counter e.m.f.

It is proved here that a high gain amplifier which provides for a free-wheeling or discharge path to the inductances of the load circuit is bound to be unstable and produce snap action over part of the operation range.

Therefore it is ill-advised to smooth the output currents and try to improve the amplifiers performance by inserting reactors in the load circuit.

This and other limitations of the existing circuits lead to the introduction of a new class of magnetic amplifiers specifically designed for a counter e.m.f. D-C load.

The philosophy behind the new amplifiers is to take advantage of the poor utilization of the cores in order to use the same and single core more than once in a cycle.

The single core yields full-wave or poly-phase output with less than half-cycle response.

Consequently the weight and the additional losses due to the poor current shape are reduced, the troublesome core matching problem is eliminated, while the fast response and the smoother available feedback signals make these amplifiers ideal for closed loop applications.

Excellent stability is achieved, over the whole control range, even with highly inductive loads.

The last two chapters are dedicated to the design of magnetic amplifiers, their field of application to variable speed drives, electrolytic processes and the related control problem. Microfilm \$2.10; Xerox \$7.40. 158 pages.

#### **SPECIFICATION OF THE LINEAR FEEDBACK SYSTEM SENSITIVITY FUNCTION ON THE BASIS OF A MINIMUM MEAN SQUARE ERROR CRITERION**

(L. C. Card No. Mic 58-2872)

William M. Mazer, D.E.E.  
Polytechnic Institute of Brooklyn, 1958

Adviser: John G. Truxal

In a linear, zero leakage feedback system, the problem of maintaining the response to a given input relatively insensitive to changes in forward gain, is considered. Minimizing the mean square variation of the response yields a criterion for the specification of the system sensitivity function, from which the compensating networks may be synthesized. Thus, both the transient and forced responses are taken into account. The necessity for providing a high loop gain with the attendant stability problem, is eliminated. The design procedure is based upon the assumption of a differential variation in the forward gain, but yields valid results for large changes in this parameter.

Microfilm \$2.00; Xerox \$4.40. 81 pages.

#### **A STUDY OF PRECIPITATION-STATIC NOISE GENERATION IN AIRCRAFT CANOPY ANTENNAS**

(L. C. Card No. Mic 58-2512)

Joseph Eugene Nanevich, Ph.D.  
Stanford University, 1958

The phenomena of precipitation static noise generation and the coupling of such noise to aircraft canopy antennas are examined. Two mechanisms of noise production are considered. One is associated with particle impact on the canopy surface, and the other is associated with over-surface (streamer) discharges.

A technique for measuring the coupling between the noise sources and the antenna is described. The technique employs a specially developed field exploring probe.

Coupling measurements made with the probe, together with basic information regarding the noise-producing mechanisms, are used to calculate noise spectra for several antennas. The calculated results are compared with noise spectrum measurements made on these antennas during flight tests conducted by Stanford Research Institute. Good quantitative agreement is obtained between the calculated and measured spectra, substantiating the theories of noise generation and coupling.

The agreement between calculated and measured spectra, furthermore, demonstrates the importance of adequate theories capable of yielding quantitative information regarding the generation and coupling of precipitation static noise. Before coupling measurements were made, it appeared that anomalous experimental spectral data had been obtained for two of the antennas employed on the flight test program. Once quantitative coupling data were available, however, it was found that the two spectra could easily be explained.

The results of this investigation indicate that canopy antenna noise should be reduced by as much as 54 db by eliminating streamering on the canopy surface. Since no suitable transparent conductive coating is presently available to eliminate streamering, several schemes for reducing noise by reducing the coupling between streamers and the antenna are suggested. The schemes suggested require relatively minor modifications in the design of present antennas.

Although the elimination of streamering or the reduction of coupling to streamers will reduce the noise level in a canopy antenna, it should not be assumed that proper canopy treatment alone will result in noise-free reception. It is possible that the noise coupled into the canopy antenna from corona discharges at the aircraft extremities may be higher than can be tolerated. Although no effort was made to investigate noise generated by corona discharges from the aircraft, the techniques of this study may be extended to the problem of corona noise. A thorough investigation of this problem would appear to be very profitable at this time in view of the many conflicting results obtained on various flight test investigations of precipitation static.

Microfilm \$2.00; Xerox \$6.40. 131 pages.

AN INVESTIGATION OF THE  
PROPERTIES OF QUARTZ CRYSTALS  
AT LIQUID HELIUM AND LIQUID  
NITROGEN TEMPERATURES

(L. C. Card No. Mic 58-2976)

Darrell Edwin Newell, Ph.D.  
State University of Iowa, 1958

Chairman: Professor L. A. Ware

The crystal oscillator field has developed to the stage where the crystal may be decoupled from the circuit sufficiently to eliminate the variations of the circuit parameters from affecting frequency stability. Consequently any new increase in stability must be obtained by perfecting the resonator. With this criterion in mind an investigation was instigated to determine the characteristics of quartz crystals from -269 to 150 degrees centigrade.

Crystals were obtained in fifteen degree angular steps about the X axis, and in thirty minute steps in the AT and BT regions, making a total of twenty-seven crystals to be investigated. Series frequency and resistance were measured in approximately twenty degree centigrade steps for each of the crystals. Liquid helium and liquid nitrogen in conjunction with an electronic oven were used to obtain the desired temperatures. Utilizing the temperature coefficient data to determine desired angles of cut, aging rate data were obtained from four crystals operating at approximately -269, -175, 70, and 174 degrees centigrade.

It was determined that the Q of a crystal can be increased by at least a factor of five by operating it in the liquid helium temperature region. The results of the aging run experiments are indicated in the table.

Crystal Temperature degrees C	Aging rate in parts in $10^{10}$ /day
-269	1
-196	5
70	59
174	54,000

It is evident that a considerable increase in frequency stability can be obtained by changing the ambient temperature of the crystal from the commonly used region of 70 degrees centigrade to the -269 degree centigrade region. Due to the difficulty in determining an exact frequency with an accuracy of 1 part in  $10^{10}$ , the aging rate figure for the -269 degree centigrade region involves appreciable error; however, the analysis used in this case utilized maximum deviation values and hence the value of 1 part in  $10^{10}$  per day is a conservative estimate. It is felt that 0.5 or even 0.1 parts in  $10^{10}$  per day would be a more accurate figure.

Microfilm \$2.00; Xerox \$7.00. 146 pages.

ACTIVE RC NETWORKS

(L. C. Card No. Mic 58-2883)

Irwin W. Sandberg, D.E.E.  
Polytechnic Institute of Brooklyn, 1958

Adviser: Professor J. Truxal

During the last decade, active RC network synthesis techniques have played an increasingly important role in network synthesis. The possibility of being able to avoid the use of magnetic elements in synthesis procedures is often inviting since resistors and capacitors are more nearly ideal elements which are cheaper, lighter, and smaller. Networks free from magnetic elements are particularly attractive when exacting performance is required at low frequencies.

Active RC networks can be designed to yield all the characteristics obtainable with RLC circuits. Moreover, the RLC characteristics yielded are merely a subclass of those obtainable with active RC networks.

The research work contained in the thesis is primarily theoretical in nature; its purpose is to focus attention upon and expose active RC network properties and synthesis procedures which are of interest to the active network synthesist. The practical point of view, beyond the phase where circuit configurations are shown to be feasible, has been considered to be of secondary importance.

The most significant points in the thesis may be summarized as follows:

(1) The characterization of active elements as controlled sources is a general approach which immediately places in evidence the essential features of physical active devices. The synthesis of active RC networks is carried out on the basis of ideal controlled sources which are, in turn, realized by practical elements such as transistors or vacuum tubes.

(2) In order that a transfer or two-terminal impedance function be realizable as an active RC network, it is necessary and sufficient that these functions be expressible as real rational algebraic fractions in the complex frequency variable. We have, therefore, considered the largest possible class of such functions consistent with linear-lumped constant theory. In particular, the realization of a general transfer or driving-point impedance function requires no more than one active element and does not necessitate the use of complicated structures such as bridged T or twin T networks.

(3) From a sensitivity point of view, a network utilizing one hybrid controlled source has far greater potentialities than a network employing the other type of controlled source. Specifically, in one case the degree of insensitivity obtainable is distinctly limited by the amount of available gain, while in the other case, at least in principle, the degree of insensitivity is arbitrary for any given non-zero value of gain.

Any given transfer function (subject to the usual basic restrictions) can be realized in an active RC-network employing two controlled sources in such a manner that the pole sensitivity function, with respect to each of the two gain constants, is simultaneously zero at every transfer function pole.

(4) The synthesis of networks which are characterized by the specification of several of their network functions is considered. Any circuit describable by a set of linear

equations can be realized as an active RC network. Several special cases are considered. In particular, a few types of constant impedance sections are developed for the purpose of cascading active RC networks.

Microfilm \$2.00; Xerox \$4.00. 73 pages.

## ENGINEERING, MARINE

### THE ADDED MASSES OF PROLATE SPHEROIDS ACCELERATING UNDER A FREE SURFACE

(L. C. Card No. Mic 58-2953)

Manfred Ronald Bottaccini, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Louis Landweber

The motion of a submerged body under accelerative forces may be divided into two components: a steady (dependent only on velocities) part and an unsteady (dependent on accelerations as well as velocities) part. The steady part has been investigated thoroughly. Unsteady motion is known only in an infinite three dimensional fluid.

This dissertation presents the theory of accelerated motion of a spheroid moving in a heavy non-viscous fluid in the neighborhood of a free surface. Use is made of the general Lagally theorem. The general form of the solution is given and special cases are described.

Microfilm \$2.00; Xerox \$3.00. 58 pages.

## ENGINEERING, MECHANICAL

### THE ORGANIZATION OF RESEARCH DEVELOPMENT AND MANUFACTURE AS APPLIED TO THE RUBBER INDUSTRY

(L. C. Card No. Mic 58-2467)

Herbert Frederick Jurgeleit, Ph.D.  
Columbia University, 1947

Manufacture falls into two main categories: Mechanical and Process. The Mechanical industries are largely concerned with parts production and assembly by the use of machine tools. The Process industries deal mainly with the treatment of materials by chemical, physical, metallurgical, and mechanical means. The Process industries, based as they are on the results of scientific research in chemistry, physics, metallurgy, and other basic sciences, are greatly influenced by modern research developments in these sciences.

Any company in the process industries is therefore constantly threatened by the devastating effects of obsolete equipment and new materials and processes. Consequently, a major problem in such companies is the periodic

re-organization of existing plant operation and the introduction of new plant processes based on the latest developments of research. The translation of newly acquired knowledge derived from basic research to economic plant processes calls for a type of organized procedure which should not only bridge the gap between the research scientist and the machine operator but which must also take into account the demands of the market. Up to now this field of organization and management has not received the attention its importance warrants.

Enormous difficulties confront industrial managers and executives of the process industries in their continuous race to keep up with modern progress. In the well-equipped laboratories of industry, scientists and research men work unrelentingly at extensive experiments and obtain results which the industrial managers are eager to put to the test of practical application. They usually look mainly to the research men for helpful suggestions on applications, but frequently find themselves defeated because of the lack of an adequate organization to function between the research laboratories and the processing departments.

In order to bridge this gap and to conciliate these widely diverging standards an effort has been made here to present a realistic and constructive plan which will co-ordinate the activities of the research and development staffs and those of the processing organizations. As a full understanding of the underlying functions and principles of both departments is a vital prerequisite for a successful solution of the problem, this co-ordination will not be accomplished merely by re-plotting of organization charts but rather thru educational progress applicable to both research and industrial management.

In analyzing a process industry one will find that it draws its sustenance from the following three fields: 1) Research, 2) Technology, and 3) Economics of Production. It is contended that the activities in these fields can be organized and co-ordinated in a single departmental procedure, and that a substantial saving of effort and time will result.

This dissertation describes the establishment of such an organization and the development of a method for solving this problem, outlines the general principles of the method and reports the results accomplished by its application in a rubber industry.

In conducting this research, the steps employed in attaining the objectives were as follows:

- 1) simplification of batches and standardization of cure time steam pressure cycles.
- 2) determination of operating characteristics of present manufacturing equipment as to cost characteristics.
- 3) with the above background, the examination of existing processes of manufacture of the Company's products with reference to the utilization of the most recent data from the research laboratories.
- 4) the re-organization of processes with reference to improvements of equality of product and the lowering of costs to meet a highly competitive market.
- 5) the development of a program for enlisting the co-operation of personnel from other divisions; Research, Cost Control, Process, Engineering, etc.
- 6) the design of new means and methods for production of old and new products by the co-ordinated activities of the personnel of the above departments.

The results obtained by the above procedures, some specific examples of which are described in more detail in

the body of this dissertation, are the following: reductions in cost, improvements in quality, increases in safety of operations, widening of the field of application of processes, and, in general, the improvement of the competitive position. Microfilm \$2.25; Xerox \$8.00. 171 pages.

## ENGINEERING, MECHANICS

### SOLUTIONS OF TWO PLASTICITY PROBLEMS BY THE DEFORMATION AND INCREMENTAL THEORIES

(L. C. Card No. Mic 58-3000)

Roger Sandberg Hanson, Ph.D.  
Iowa State College, 1958

Supervisor: Glenn Murphy

This dissertation is a comparison of the incremental theory and the deformation theory of the mathematical theory of plasticity by application of both theories to two boundary value problems.

The two problems that are solved are the problem of the quench of an infinitely long circular cylinder at uniform temperature rapidly enough to induce plastic flow, and the heating by induction of a thin circular disk at the rim to cause plastic flow. Stresses and strains are found for both problems by both theories and the results are presented in graphical form for comparison. The equations resulting are solved by an iterative scheme by an IBM digital computer.

Experimental work is presented for the problem of the thin circular disk by measurement of residual stresses by means of the SR-4 strain gage used as a principal stress gage.

The Pradtl-Reuss incremental equations are used in the solution to the incremental portion, and the usual assumptions of the deformation theory are used for solution of that portion.

Both theories are found to give the same results during the loading stages, but when the material unloads, widely differing results are found.

Microfilm \$2.70; Xerox \$9.20. 205 pages.

### CARRYING CAPACITY OF ELASTIC-PLASTIC SHELLS WITH VARIOUS END CONDITIONS UNDER HYDROSTATIC COMPRESSION

(L. C. Card No. Mic 58-2873)

Burton Paul, Ph.D.  
Polytechnic Institute of Brooklyn, 1958

Adviser: P. G. Hodge, Jr.

The limit load of a short rigid-plastic cylindrical shell, subjected to radial pressure only, represents a good approximation to the carrying capacity of the more realistic

elastic-plastic shell. When axial loads are also present the so-called beam column effect tends to reduce the carrying capacity of the elastic-plastic shell. In this dissertation an approximate value of the carrying capacity, including the beam column effect, for a completely plastic shell in a hydrostatic pressure field is derived. Specific problems considered include shells with clamped ends, simply supported ends, and a combination thereof. Detailed results are presented graphically along with general conclusions useful for design purposes. A comparison with known results of elastic buckling theory is presented. A detailed numerical example illustrates the complete history of deformation for a specific case and shows that the maximum deflection increases indefinitely as the load approaches the predicted fully plastic mode of collapse.

Microfilm \$2.00; Xerox \$4.00. 72 pages.

## ENGINEERING, METALLURGY

### THE MECHANISM OF BENEFICIAL EFFECTS OF BORON AND ZIRCONIUM ON CREEP-RUPTURE PROPERTIES OF A COMPLEX HEAT RESISTANT ALLOY

(L. C. Card No. Mic 58-3651)

Raymond Frank Decker, Ph.D.  
University of Michigan, 1958

A microstructural investigation was pursued to establish the mechanism of the pronounced benefits of boron and zirconium on creep-rupture properties of a 55 Ni - 20 Cr - 15 Co - 4 Mo - 3 Ti - 3 Al alloy at 1600°F.

Materials with varying boron and zirconium content were exposed to creep conditions and then the microstructures were analyzed by optical and electron microscopy, electron diffraction, microfractography and hardness measurements. Particularly useful were interrupted creep tests which allowed comparisons of materials after equivalent creep exposures.

The mechanism of improvement of creep-rupture properties was found to be a pronounced stabilizing effect of boron and zirconium on the grain boundaries of the alloy. The alloy with low boron and zirconium was subject to rapid agglomeration of  $M_{23}C_6$  and  $\gamma'$  ( $Ni_3(Al, Ti)$ ) in the grain boundaries, followed by depletion of  $\gamma'$  and intergranular micro-cracking at the grain boundaries transverse to applied stress. Brittle fracture then occurred by linking of micro-cracks. However, additions of zirconium, boron and boron plus zirconium decreased this tendency in that order. In the absence of these elements extensive micro-cracking was found early in second stage creep at relatively short time periods and fracture occurred prematurely with very little deformation. Proper amounts of boron plus zirconium delayed micro-cracking until after third stage creep started so that creep-rupture life was greatly prolonged and ductility to fracture markedly increased.

No effect of the trace elements on the size, amount and distribution of the intragranular  $\gamma'$  was detected. Accordingly, the property effects were not found to result from a change in the intragranular  $\gamma'$  reaction.

An estimate of the generality and limitations of the mechanism is given in the report. It appears that the effect of boron and zirconium generally would be to retard agglomeration of phases in the grain boundaries of heat resistant alloys.

Consideration is given to the cause of the stabilizing influence of the trace elements. The most feasible explanation is equilibrium segregation of boron and zirconium to grain boundaries, lowering the energy level of the grain boundaries and thereby reducing the tendency for carbon segregation to the grain boundaries.

Microfilm \$2.00; Xerox \$4.40. 81 pages.

#### SATURATION MAGNETIZATION OF MANGANESE ALLOYS

(L. C. Card No. Mic 58-3075)

Arnold Harold Holtzman, Ph.D.  
Lehigh University, 1958

The saturation magnetization of manganese alloys was discussed in terms of an atomic model. On the basis of this model a critical separation between nearest neighbor manganese atoms was considered to be the upper limit for antiparallel magnetic vector alignment and consequently the lower limit for parallel alignment. Ordered FCC and BCC crystal structures were considered for ferromagnetic and ferrimagnetic possibilities.

Metallographic, structural, and magnetic studies were made on alloys in the ternary systems Mn - Ni - C and Mn - Co - C. An ordered FCC phase of stoichiometric composition  $Mn_2Co_2C$  was found to be markedly magnetic. An atomic model was deduced for this phase which was consistent with and could account for the observed magnetic data. Magnetic and thermodynamic data were interpreted as indicating that the ordered structure is induced by magnetic interactions. The magnetic structure of  $Mn_2Co_2C_1$  was considered on a two sub-lattice basis. The sub-lattices have parallel alignment although one of them is internally antiparallel.

Microfilm \$2.00; Xerox \$7.00. 148 pages.

#### SHORT CIRCUIT DIFFUSION

(L. C. Card No. Mic 58-3241)

George Thomas Murray, Eng.Sc.D.  
Columbia University, 1958

Experiments were conducted to measure the short circuit diffusivities of silver and nickel along dislocations, introduced by bending, and grain boundaries in silver. The self-diffusivity of silver along grain boundaries was in fair agreement with that of previous investigators. The discrepancy could be explained on the basis of material lost from the short circuit path to the bulk material. The dislocation diffusivity for silver self diffusion was too small to be measured by the techniques of the sensitivity employed here. It was found that this diffusivity was less than that of the grain boundary self-diffusion.

The diffusivities of nickel along grain boundaries in silver were found to be  $4.7 \times 10^{-9}$  and  $3.4 \times 10^{-8} \text{ cm}^2 \text{ sec}^{-1}$  at  $450^\circ\text{C}$ . and  $500^\circ\text{C}$ . respectively. The results indicated that the solubility of nickel in the silver grain boundary was much larger than in the lattice proper. The dislocation diffusivity of nickel in silver was also too small to be measured and is thus less than the grain boundary diffusivity.

Microfilm \$2.00; Xerox \$4.00. 71 pages.

#### PLASTIC DEFORMATION AND ANNEALING PROCESSES IN AN ALLOY OF FIVE WEIGHT-PERCENT BERYLLIUM IN IRON

(L. C. Card No. Mic 58-3080)

Roger Harry Richman, Ph.D.  
Lehigh University, 1958

An alloy of five weight-percent (24.6 atomic percent) beryllium in iron was prepared by double melting electrolytic iron and beryllium under a partial pressure of purified helium. Small specimens were cut from the ingots after homogenization, and quenched in water from a temperature of  $1130^\circ\text{C}$  to retain the body-centered cubic solid solution. Optical metallography and X-ray diffraction were used to study the processes occurring in this alloy during compression, cold-rolling, and annealing.

It was found that the substitution of beryllium into the crystal lattice of iron suppresses slip and causes plastic flow to proceed almost entirely by mechanical twinning in the initial stage of deformation. The change in the deformation mode from slip to twinning is attributed to electronic effects of alloying which manifest themselves as an atom-size difference leading to lattice strain, and short-range ordering to minimize the lattice distortion. Both of these factors are thought to make slip less energetically favorable than twinning.

In addition to the preponderance of  $\{112\}$  twins, three new types of twins were discovered in the BCC structure by the pole-locus method of stereographic analysis. The habit planes are  $\{130\}$ , near  $\{045\}$ , and near  $\{2, 3, 10\}$ ; analysis of twin intersections yielded the  $\{130\}$  elements  $K_1 = (130)$ ,  $K_2 = (\bar{1}54)$ ,  $n_1 = [315]$ , and a shear of 1.871. Incipient departure of the structure from cubic symmetry is credited as the cause of the new twin modes.

No correlation of twinning to brittle fracture was found. That is, profuse twinning without fracture and cleavage essentially without twinning were both observed.

Fine-grained beryllium-iron strip can be cold-rolled 90 percent or more without an intermediate anneal. A reduction of 86 percent produced a preferred orientation with the separate components  $\{100\} \langle 011 \rangle$ ,  $\{111\} \langle 011 \rangle$ , and a weaker  $\{111\} \langle 112 \rangle$ . Annealing the cold-rolled strip for ten seconds at  $900^\circ\text{C}$  produced a texture consisting of  $\{111\} \langle 112 \rangle$ ,  $\{110\} \langle 001 \rangle$ , and a partial  $\{110\} \langle 225 \rangle$ . The recrystallized orientations are related to the  $\{100\} \langle 011 \rangle$ ,  $\{111\} \langle 112 \rangle$ , and  $\{111\} \langle 011 \rangle$  deformation components by rotations of  $16^\circ$ ,  $35^\circ$ , and  $35^\circ$ , respectively, about common  $\langle 110 \rangle$  axes.

Annealing the deformed alloy at temperatures below  $800^\circ\text{C}$  causes precipitation at twin intersections and secondary twins, and absorption of twin bands by the parent grains. Temperatures of  $800^\circ\text{C}$  or above result in

recrystallization of specimens deformed more than nine percent; recrystallization at the lower end of the temperature range may be preceded by almost complete absorption of twins by the parent grains. The recrystallization in material strained 10 to 70 percent was accomplished by new, strain-free grains of three types, namely (1) grains in twin relation to the deformed parent, formed by swelling of Neumann bands, (2) grains of approximately the same orientation as the deformed parent, and (3) grains of neither the parent nor a twin orientation. The origin of the first two types is apparently strain-induced boundary migration.

Undeformed specimens of five percent beryllium-iron were annealed at 400°C and 520°C. The 400°C treatment produced a relaxation of cubic symmetry and what appeared to be X-ray evidence of long-range order as part of the preprecipitation sequence. Neither of these effects accompanied the 520°C annealing, but the lattice parameter did show a small contraction during the early stages of aging. The crystal structure of the metastable phase was not determined. Microfilm \$2.05; Xerox \$7.40. 156 pages.

## ENGINEERING, SANITARY AND MUNICIPAL

### VERTICAL-SLOTTED INLET BAFFLES FOR SEDIMENTATION BASINS

(L. C. Card No. Mic 58-2975)

Gordon E. Mau, Ph.D.  
State University of Iowa, 1958

Co-Chairman: Professor Philip F. Morgan and  
Professor Chesley J. Posey

Theories about how individual factors, which are important in sedimentation processes, can be used to best advantage in a basin are discussed. Frequent reference to contemporary writings shows general disagreement regarding both the theory and application of some of these factors. A need is established for basic studies which deal primarily with inlet conditions, but which do not ignore other factors in sedimentation.

Slotted inlet baffle studies by Rohlich and Müller-Neuhaus, and the consideration of basic fluid mechanics theories, indicate that slotted inlet baffles give the most promise of all inlets considered to date of helping to effect

the best basin performance in solids removal. Neither of these two studies provide sufficient information for widespread use of these inlets in design. Information pertaining to such items as the ranges in slot width, slot spacing, slot velocity, and basin velocity are lacking. Therefore, this study was undertaken to obtain information about these and other related items.

This study shows that the most efficient arrangement for a single slotted inlet baffle has little, if any, value in most sanitary engineering projects. Optimum results are obtained when slot spacings do not exceed 0.4 ft and when the velocity through the slots is at least 0.5 fps. These conditions usually limit slot widths to from 0.005 - 0.03 ft. Rohlich's data are in agreement with the curves established by data from the single slotted baffle in this study.

A submerged inlet behind a baffle, which extended about one-third the basin depth, effects nearly as good a flow distribution as a single slotted inlet baffle for basin depths of 1 and 2 ft. However, observations with methylene blue dye indicate that the slotted inlet baffle causes a more uniform movement of water through the basin.

Results show a double slotted inlet baffle (two slotted baffles in series) to be much more efficient than the single slotted baffle. The double baffle has wide application because the inlet is very effective when: (1) slot spacings are as large as 1 ft; (2) first baffle slot widths are 0.08 ft or more; (3) velocity through the first baffle is as low as 0.1 fps; (4) the distance between baffles is 0.3 - 0.5 ft; and (5) the second baffle width is 0.23 - 0.32 ft, but slightly wider than the first baffle slots.

Slotted baffle inlet data from this study are compared with the results from an air tunnel study by Baines and Peterson. Both result in similar general conclusions about the Reynolds' number. This study also shows that the Reynolds' number of the inlet is far more important than the Reynolds' number of the basin and that the solidarity ratio is not a satisfactory method of describing the inlet.

A minimum velocity of 0.5 fpm through the basin is indicated for basin stability. This minimum velocity and an inlet which distributes the flow uniformly throughout the vertical cross-section of the basin are very important. When these two criteria are satisfied, basin shape relationships (L:W:D) appear to have little significance.

Dimensionless expressions permit a direct comparison of data from different tests. Data are plotted such that one factor is kept relatively constant so that its effect on basin performance may be evaluated. A total of 51 figures is used in presenting the data.

Practical applications of the findings are presented. Also, tracers and methods used for determining representative data are discussed.

Microfilm \$2.45; Xerox \$8.60. 187 pages.

## FINE ARTS

### THE SCULPTURE OF THE CATHEDRAL OF AMIENS: A DESCRIPTIVE, ICONOGRAPHIC, AND STYLISTIC STUDY BASED ON THREE-DIMENSIONAL SLIDES IN THE COLLECTION OF THE STATE UNIVERSITY OF IOWA

(L. C. Card No. Mic 58-2967)

Donald Gray Humphrey, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Lester D. Longman

This dissertation is a descriptive, iconographic, and stylistic study of the sculpture of Amiens cathedral, based on three-dimensional slides in the collection of the State University of Iowa.

The first chapter is a brief history of the city of Amiens and the cathedral. In chapter two the West façade is described and analyzed with respect to its architectural, sculptural, and iconographic logic, harmony, and organic unity. The symbolic position of the prophets on the pier buttresses of the West façade is discussed in the third chapter, which also includes a study of the biography, prophecies, or visions depicted in the quatrefoil reliefs below each prophet, and the significant relationship of the Old to the New Law, as envisaged by the Church Fathers and the Medieval theologians.

The next three chapters analyze the sculpture of the three West portals. Evidence from the legends of the Apostles is introduced to show that in all probability those who planned the iconographic program had intended a specific relationship between each of the Apostles of the Beau Dieu portal and particular and appropriate Virtues and Vices sculptured in the quatrefoil reliefs of the soubassement. The identification of certain local saints of Picardy by the cathedral's primary biographer, M. Georges Durand, is shown to be based on the false assumption that the statues represented on the embrasures of the Saint Firmim portal were those whose relics were owned by the cathedral at the time it was built. Several different attributions are proposed, based on hagiographical evidence.

Chapter seven discusses Gothic dualism and the

conceptual, social, and professional milieu of the thirteenth century sculptor. It attempts to show that of all the French cathedrals, Amiens best mirrors the essence of French character. Erwin Panofsky's Gothic Art and Scholasticism, whose thesis that the Gothic architect was a product of a Scholastic "habit of mind," which accounts for the forms, is here extended to include the sculptor. The organization and technical aspects of the thirteenth century French chantier are examined.

In the same chapter, Amiens is compared with Notre Dame of Paris, Chartres, and Reims. Notre Dame of Paris is cited as the cathedral which best reflects Gothic rationale and Scholasticism, Chartres is characterized by strong mystical tendencies, and Reims is the royal cathedral. The undeniable bourgeois qualities of Amiens are re-examined in a more positive sense, and the conclusion is drawn that this cathedral is most nearly the national cathedral of France in reflecting the salient qualities of the French character.

The term "frank" was used by Ruskin in The Bible of Amiens to suggest that the history of the Franks is closely associated with Amiens, and that the definitive character of the cathedral is "frankness," expanded by Ruskin to include "free" and "truthful." The partial, but emotionally weighted truth of this argument is criticized. The style and character of Amiens cathedral are analyzed by reference to specific works of sculpture, in which a good-natured quality predominates, reinforced by middle class practicality, a love of the concrete held in tenuous balance by an overlying sense of the ideal, and a provincial rusticity.

Chapter eight describes and analyzes the South transept portal of the Vièrge Dorée. The trumeau statue of the Virgin is compared with other thirteenth century statues of the Virgin as stylistic reflections of different attitudes in the development of the cult of Mary.

Chapter nine treats several sculptures of the South flank of the cathedral, dating from the fourteenth century. The last chapter is primarily concerned with the late fifteenth and early sixteenth century choir enclosure sculptures which, despite a few superficial Renaissance aspects, are still within the flamboyant Gothic tradition.

Microfilm \$3.80; Xerox \$13.00. 296 pages.

## FOLKLORE

### A MOTIF-INDEX OF THE FOLKTALES OF CULTURE-AREA V WEST AFRICA

(L. C. Card No. Mic 58-2904)

Kenneth Wendell Clarke, Ph.D.  
Indiana University, 1958

A motif-index of West African folktales has been compiled as a supplement to Professor Stith Thompson's Motif-Index of Folk Literature. In all important features of format and classification, it follows the model established by the revised edition of Professor Thompson's index (Bloomington, Indiana University Press, 1955-57).

The culture-area concept was employed to provide an arbitrary limit to the extent of the study so that the published folk literature of the area might be classified in considerable detail. The folklore as one factor in the ethnology of an area might be expected to conform in some ways with the distribution of other factors which determine the boundaries

of the area. Future studies of other culture areas in Africa may serve to test this hypothesis. However, the major purpose of this classification is to provide a bibliographical tool for researchers who wish to make comparative and historical studies of folktales or related materials.

This dissertation should be of special interest to the researcher who wishes to make a study of collected folktales of New World Negroes. Culture-area 5 is on the west coast of Africa, the source of much of the New World Negro population. A motif-index of the native tales on that area will facilitate studies of the survival of Old World motifs in a transplanted ethnic group. The complexity of the distribution of motifs in world folklore makes a detailed motif-index of a specific area a potentially useful tool to researchers in a variety of pursuits.

Because the index follows Professor Thompson's pattern, making use of a logical order based on alphabet and a decimal system, its arrangement is self-explanatory.

Microfilm \$7.55; Xerox \$26.40. 596 pages.

## FOOD TECHNOLOGY

### PHYSICAL AND CHEMICAL PROPERTIES OF ALPHA AMYLASE OF BACILLUS STEAROTHERMOPHILUS

(L. C. Card No. Mic 58-3047)

Gilbert B. Manning, Ph.D.  
State College of Washington, 1958

This study deals with the crystallization of the thermo-resistant, extracellular alpha amylase produced by the thermophile Bacillus stearothermophilus, and the properties of the enzyme which endow it with heat resistant characteristics.

The enzyme was found to possess a high affinity for the substrates, starch and branched-chain amylopectin. The optimum temperature range of activity was 60°C. to 80°C. The pH optimum range for starch hydrolysis was pH 4.6-5.1, and calcium was required for optimum activity.

The enzyme lost 29 per cent of its initial activity after twenty hours at 80°C. However, there was no inactivation in the presence of the denaturing agents, 8 M urea or 4 M guanidine hydrochloride. The enzyme was not inhibited by the sulfhydryl inhibitor, N-ethylmaleimide and further studies substantiated the absence of free sulfhydryl groups in the molecule. The lack of denaturation observed indicates a high degree of resistance to molecular dissociation.

A minimum molecular weight of 15,174 was calculated from amino acid analyses. The presence of high amounts of the acidic amino acids, aspartic acid, and glutamic acid were found as well as a complete lack of imidazole, guanidyl, lysyl, and phenolic groups. The acidic nature of the molecule was further confirmed by potentiometric titration and dye binding experiments. The presence of 43.8 per cent phenylalanine in the molecule was observed.

Solutions of the enzyme exhibited a specific rotation of  $-98^\circ$  which indicate a random coil type of molecular arrangement. This arrangement is attributed to the presence of 13 per cent proline in the molecule. The random coil arrangement is further supported by calculation of a molar frictional ratio ( $f/f_0$ ) of 1.85 from diffusion and sedimentation measurements indicating extreme deviation from a spherical molecular shape. Calculations of sedimentation constants showed that the greater the presence of calcium, the greater the sedimentation constant. In these experiments it was found that the enzyme appears able to complex with calcium forming multiples of the basic 15,000 molecular weight unit.

The isoelectric point was found to be less than pH 6.0. The mobility increases with increases in pH, attesting to the presence of a large amount of negatively charged residues.

Microfilm \$2.00; Xerox \$4.60. 89 pages.

## GEOGRAPHY

### ANALYSIS OF THE SPATIAL RELATIONSHIPS AMONG AGRICULTURAL PHENOMENA IN IRAQ, 1953

(L. C. Card No. Mic 58-2950)

Ali Mohammed Al-Maiyah, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Harold H. McCarty

The purpose of this study has been to investigate the factors underlying the spatial variation in agricultural phenomena in Iraq in the year 1953. A tentative solution to this problem was suggested by the formulation and subsequent testing of the following hypothesis: agricultural phenomena in Iraq grow increasingly complex in a consistent and cumulative manner, and that fairly definite areas of similar agricultural production can be detected.

In considering what were thought to be the relevant variables ratios were used instead of absolute values to avoid size differences among the areal units and to stress the relative importance of each variable. These ratios were based on the actual farmland area in the standard administrative unit (*nahia*) rather than on total land area. The reason for this was to exclude all desert areas and waste lands, and to measure the actual effective agricultural territory.

Emphasis was given to the dominant type of agricultural in the country, namely extensiveness, and areal variations among agriculture phenomena have been considered with respect to this particular type. In view of the fact that the concept "extensiveness involves a large number of associated phenomena, it was desirable to measure its presence in an area in terms of several phenomena. Accordingly, agricultural development in the various *nahias* of Iraq has been measured in several ways and the manner in which these aspects are associated in the various areas has been determined by scalogram analysis. This study in effect constitutes an exploratory application of scalogram analysis in geographic research.

Scalogram analysis was employed to rank the *nahias* according to their similarity by reference to the criteria, which in turn were ordered in terms of commonality; from the least common to the most common in the national area.

Scaling is preferable to partial and multiple correlation techniques because it can be used: (a) to determine the pattern of association among a number of variables; (b) to handle skewed distributions; and (c) to avoid an assumption of linearity. The analysis produced several scale types of similar extensiveness, and offers a complete picture of the interrelationships between the various measures of extensiveness and the internal structure of each scale type. In addition to differentiating the *nahias* on the basis of degree of extensiveness, the use of scalogram analysis makes possible the contrasting of *nahias* with respect to the kinds of intensive and extensive agriculture.

To test the validity of the classification and to isolate the factors which account for variations in the areal combination of the variables studied, analysis of variance was

employed. However, since there must be not only a significant difference between the means of the several scale types, but also a progression in regional magnitude relative to the degree of extensiveness, analysis of variance was supplemented by inspection of the different scale types means.

The study indicates that variations of agricultural phenomena in Iraq do not reflect solely an association with physical factors, but that cultural, economic, and biological factors are important as well. Therefore, the study represents a new approach to the discussion of agricultural phenomena in Iraq, which is in contrast to the conventional method of discussing such qualitative features as rain-fed areas and irrigated areas, or summer crops and winter crops. Furthermore, it is believed that the techniques and methods employed in this work may have wider application and warrant further consideration as a valuable aid in geographical research.

Microfilm \$2.00; Xerox \$6.20. 126 pages.

### THE SAVANNA OF CENTRAL PANAMA: A STUDY IN CULTURAL GEOGRAPHY

(L. C. Card No. Mic 58-2842)

Robert Henderson Fuson, Ph.D.  
Louisiana State University, 1958

Supervisor: Professor Robert C. West

This study of the savanna of central Panama is primarily one of cultural geography; it deals with the relationships between culture and nature. From the time of Indiana dominance up to the modern era, central Panama has been a center for the concentration and origin of culture traits that have spread to adjacent areas. In this respect it may be considered the cultural hearth of Panama. The central savanna has functioned as the Panamanian hearth since the pre-Hispanic Coclé peoples attained a relatively high civilization in the area. Spain successfully introduced its culture to Panama in the sixteenth century, and the former Indian culture was submerged, though not totally destroyed. Indian culture and race were blended with that from Iberia. A new race, the *mestizo*, emerged to bear a new culture that was neither all Indian nor all Spanish.

More than three years of library and archival research preceded the writing of this study. An entire year (1955-56) was devoted to field work in the Republic of Panama. Final composition was done at the Department of Geography and Anthropology, Louisiana State University, and at the University of Miami, Florida.

The question of the genesis of the savanna is the primary physical problem of the work. Man is seen as an important force in modifying the natural landscape, in interaction with climate, soil, and vegetation. The discussion

of this, in Chapter I, serves as a physical basis for an understanding of the five succeeding, culturally oriented chapters.

It is possible to understand the present man-land relationships only if the historical and prehistorical ones are first comprehended. Special attention is given in Chapter II to population and settlement from pre-Columbian times to date. From this comes an awareness that settlement types and forms, and population have diffused from the savanna hearth. Another significant feature of the cultural landscape is the rural dwelling, discussed in Chapter III. Two distinct house types prevail today in the area: one is basically Spanish; the other, Indian. Investigation of the rural dwelling affords an excellent opportunity to sift and sort cultural elements from a larger complex. In so doing it is learned that Spanish traits predominate. The same Iberian dominance is again noted in Chapter IV, which deals with rural economies.

Nothing is more basic to cultural geography than man's use of the land. Therefore, more space is devoted to agriculture, animal husbandry, and related activities than to certain other aspects of material culture. Evidence is offered to support the view that the modern Panamanian agricultural complex is essentially of Spanish origin. Iberian supremacy is further observed in the realm of trade, transport, and communications, covered in Chapter V.

Analysis suggests that the Indian made the following major contributions to the cultural landscape: (1) he altered the natural environment with fire; (2) he was responsible for one of the two basic house types; (3) he had become thoroughly familiar with virtually all useful native plants before the Conquest, and had domesticated many of them; (4) he established population centers that still persist; and, (5) he developed avenues of trade and communication. The latter served for the dispersal of Spanish culture as it had served for Indian dispersals.

All of the above-mentioned Indian contributions have merged with similar Spanish elements. Furthermore, countless European traits were added to the existing aboriginal complexes; even new complexes were introduced. Colonial Spain provided an extensive livestock complex; modern North America, the automobile complex. For these reasons, the cultural landscape of central Panama today is generally European and specifically Iberian.

Microfilm \$6.20; Xerox \$22.00. 487 pages.

#### **PATTERNS AND PROBLEMS OF LIVESTOCK PRODUCTION IN MALAYA**

(L. C. Card No. Mic 58-3664)

Lee Anthony Peter Gosling, Ph.D.  
University of Michigan, 1958

Livestock production in Malayan economy is of much smaller importance than either agricultural food production, commercial plantation production or mining. The actual number of animals as measured by Western standards is small in relation to the population; diets are short in animal proteins and Malaya does not even produce what little it consumes. Although there is little traditional interest in animal husbandry as such, animal production is intricately woven into the complex ethnic and economic fabric of Malayan life.

Malayan animals, from buffalos to monkeys, have functions different from those of animals in western agriculture. The larger beasts are used as sources of cultivation power but also have other functions as investment and prestige; meat production is secondary and incidental. The smaller animals, intended primarily for food purposes, are of poor quality from degenerative breeding and meagre diet. The rigour of animal life in rural Malaya is such that the animal population of the country represents the survival of the most resistant rather than the most productive.

The distribution patterns of the various animals are conditioned by the characteristics of the animal, their functions in the rural economy, and the distribution pattern of the particular ethnic group with which the animal is associated.

The improvement of livestock production in Malaya depends on the solution of several problems. On these problems the agencies of the Malayan Government have been and are now busy, and the results are encouraging. Endemic animal disease is fairly well controlled; experiments with animal breeding and introduction of new breeds have indicated possible livestock improvement programs. The rudimentary marketing and distribution schemes, complicated by interlocking debt arrangements, can be improved with controlled marketing and adequate rural credit. Perhaps the major unsolved problem is that of animal nutrition; there is only a limited amount of forage and pasturage in a tropical country where land for direct food production is scarce. Experimental introduction of forage crops and establishment of improved pastures have not yet provided a solution.

The problems of animal production and use are complicated by the heterogeneous nature of the Malayan population. Among the three principal ethnic groups there are social customs and religious prohibitions which proscribe or discourage variously the use of bovine flesh, pork or milk; customary usages and prejudices inhibit the application of certain remedial measures. Therefore, the greatest difficulties lie not in the technical but in the social phases of these problems. Before much headway can be made the Malayan peasant must be convinced of the desirability of changed and improved animal husbandry; any overall general program must fit into the complex of different ethnic groups and within the framework of the intricately interwoven rural economy.

Microfilm \$3.95; Xerox \$13.40. 308 pages.

#### **THE PROCESS OF SOCIO-ECONOMIC CHANGE, AS IT PERTAINS TO EARLY POST WORLD WAR II DEVELOPMENTS IN AUSTRALIA, HAVING DIRECT INFLUENCE ON THAT NATION'S POSTWAR EMERGING INTERNATIONAL TRADE PATTERNS**

(L. C. Card No. Mic 58-3673)

George Rex Henrickson, Ph.D.  
University of Michigan, 1958

The central problem of this study is concerned with an analysis of certain processes of economic, social, and political change, with respect to the way in which they help to account for a variation in the nature of Australia's external trade during the early post World War II years. Wherever possible, the writer has attempted to determine

and present those cause-and-effect relationships which he felt would contribute in some measure to a clearer understanding of various Australian international trade patterns which have evolved.

Chapter I of this study outlines the development of Australia's international economic policies and trade patterns prior to 1946, the basic purpose of which has been to set forth those courses of events which form the background for an assessment of the postwar period. Chapter II provides an introduction to the base period under study, that is the years from 1946 through 1948. Here reference has been made to current conditions and prospectus with respect to the pastoral and agricultural, the manufactural and the commercial segments of the Australian economy.

Chapter III analyses the importance of pastoral and agricultural activity to Australian production and international trade. It outlines the noticeable dependence of that country upon its rural products and emphasizes the close relationship between its ability to sustain a healthy rural economy and its capacity to acquire a desired amount of commodities from overseas sources of supply.

Chapter V considers the importance of manufactural activity to the Australian economy, with detailed reference being given to its potential ability to produce a selected range of commodities. It portrays the geographic situation of this industry, its developing stature, the problems with which it is confronted and the threat which increased local production may tend to offer manufactural imports.

Chapter VII deals with the subject of postwar population expansion in Australia and discusses its significance with respect to the fields of production and international trade. Sections are devoted to an introduction to the population problem, to population characteristics and to the postwar immigration program, including its political, social and economic implications. Chapter VIII outlines the evolution of Australia's national health and medical benefits program and suggests its significance to the special subject matter of this study.

Chapters IV, VI and IX concern themselves with an analysis of Australia's international trade during the years 1946, 1947 and 1948. A general consideration has been given to the overall foreign trade patterns which have developed, with respect to Australia's commercial dealings with its more important trading partners. More detailed attention, however, has been focused on its trade transactions with the United States and specifically to its purchases of a selected cross-section of United States exports, with special reference being given to DeVilbiss medicinal atomizer products.

Microfilm \$4.15; Xerox \$14.00. 321 pages.

## GEOGRAPHY IN THE POLITICS OF FLINT

(L. C. Card No. Mic 58-3700)

Peirce Fee Lewis, Ph.D.  
University of Michigan, 1958

Politics differ from place to place, and the differences can be shown on maps of election returns. Political attitudes and group voting, however, are related to certain population characteristics, and the latter are mappable too. A comparison of maps, therefore, should reveal the nature of group voting, and the purpose of the present study is to determine how effectively such comparisons can be made. Such a test is desirable because students of voting behavior have made little use of maps except as illustrations or as places to record data; the analytic function of maps has been largely neglected. The statistical techniques which have been used most often, however, frequently require larger expenditures of time and money than map analysis does. Conclusions from maps may be less precise than those from statistical analyses, but map interpretation is not necessarily less meaningful.

The city of Flint, Michigan, was used as a testing ground for cartographic study of voting behavior. Three kinds of voting were mapped by precincts for purposes of the analysis: for the major parties, for third-parties, and for controversial referenda and Constitutional amendments. The maps were then interpreted singly, in series, and by comparison with maps of economic level and Negro population. Map overlays were drawn to make comparisons as explicit as possible.

Four major elements of group voting since 1928 were discovered in Flint:

1) The pattern of Flint's party loyalties is the product of the early Depression years. Before 1930, Flint had been staunchly Republican, with no great differences from one area to another. Major areal differences developed between 1930 and 1936; the general pattern has changed only in detail since that time.

2) The relationship between income and party voting has been very strong in Flint, with high-income groups voting heavily Republican, and low-income groups heavily Democratic. While the relationship had undoubtedly existed for a long time, it became very pronounced early in the Depression and has been that way ever since.

3) Flint's Negroes were largely Republican up to 1932, but had become a mainstay of Democratic strength by 1950. The poorer Negro groups had switched their loyalties quickly and were largely Democratic by the mid-'30's, but those of higher income changed more slowly and could not be considered "safely" Democratic until 1948.

4) In non-partisan voting, economic and racial factors have played a lesser rôle than in partisan voting.

Flint was found to be too small, too young, and too uniform however, to allow much range of inquiry. Future cartographic analyses would better be undertaken in a larger city, or perhaps for a whole state on a township basis. Nevertheless, Flint was an adequate example to prove the thesis on which the study was based: that maps are valuable analytic tools for the study of voting behavior.

Microfilm \$2.00; Xerox \$7.20. 151 pages.

## CONODONTS OF THE GALENA FORMATION

(L. C. Card No. Mic 58-2958)

Raymond L. Ethington, Ph.D.  
State University of Iowa, 1958

Chairman: Professor William M. Furnish

Previously undescribed conodonts obtained from acid residues of the Galena Formation in Iowa and Minnesota are described. The long standing question of the correlation of this unit still exists, but the new fauna recovered from the three members of the Galena provides additional criteria for age determination. The conodont fauna consists of 48 species which are referred to 26 genera. Of these genera, *Coelocerodontus*, *Goniodontus*, and *Rhynchognathus* are new. *Belodina* is proposed for species formerly assigned to *Belodus*, and *Panderodus* is established for forms previously placed in *Paltodus*. Well preserved conodonts are abundant in the limestone facies of the Galena whereas they are rare and poorly preserved in the dolomite facies of that formation. Conodonts from the lower Prosser represent a continuation of the fauna of the Decorah Formation and are very similar to the conodonts of the Kimmswick of northern Missouri and the lower Viola of Oklahoma. A probable late Mohawkian age for these strata is indicated. Faunal elements introduced in the upper Stewartville and Dubuque suggest an Early Upper Ordovician age for these beds. Detailed correlation of the members of the Galena Formation with the standard Ordovician section in the eastern United States can not be accomplished at this time owing to incomplete knowledge of the faunas of the type Trenton and Cincinnati.

Microfilm \$2.10; Xerox \$7.40. 159 pages.

CLAY MINERAL STABILITY AND  
GENESIS DURING WEATHERING

(L. C. Card No. Mic 58-2915)

Jack Lamar Harrison, Ph.D.  
Indiana University, 1958

In an attempt to learn more about the genesis and stability of clay minerals during weathering, samples were collected from two weathered shales, the profiles of which extended from fresh unweathered shale at the bottom to highly weathered material at the top. Samples were also collected from three shale-underclay profiles to see if clay mineral changes in these profiles were comparable to those in the weathered shale profiles. X-ray diffraction and chemical analysis were the primary methods of studying the variations within the profiles. Analysis for Fe, Mn, Ti, and K, was done by X-ray fluorescent spectrography, Mg and Ca by titration, and Na by flame photometry.

Significant changes in both amount and type of clay minerals present were discovered. Montmorillonite formed at the expense of chlorite. Chemical analyses suggest that the montmorillonite formed is a so-called hydrogen montmorillonite type. The chlorite present is probably of the iron-rich species as deduced from the low intensity of the odd-order diffraction peaks. The oxidation and removal of iron from chlorite may permit the entrance of  $H_2O$  and subsequent formation of a hydrogen montmorillonite. This conversion is not instantaneous, however, and although a pure montmorillonite is not produced in any of the profiles, mixed-layer chlorite-montmorillonite seems to be an intermediate product.

Illite is also subject to destruction with concurrent formation of montmorillonite. The ionic radii of  $K^+$  and  $H_3O^+$ , 1.33 Å and 1.4-1.5 Å respectively, are very similar, so that mutual replacement of  $H_3O^+$  and  $K^+$  seems feasible crystallochemically. Analysis for  $K_2O$  shows that it decreases in percentage with increase in amount of montmorillonite.

The conversion of illite to montmorillonite takes place by formation of a mixed-layer illite-montmorillonite complex. This mixed-layer mineral is neither the regularly nor randomly interstratified type, but rather is a "segregated" mixed layer species in which zones of varying densities of montmorillonite layers are interspersed throughout the illite layers. The montmorillonite may be present as "islands" within the illite structure, so that its density may vary in both the a and b crystallographic directions as well as in the c direction. The formation of this type of mixed-layering is reflected in the diffraction patterns by asymmetry on the low-angle side of the (001) peak of illite, asymmetry on the high-angle side of the (003) peak, and broadening of the (002) peak.

Changes in the kaolinite content of the samples studied were slight. The proportion of kaolinite present did not change appreciably with depth in any of the profiles.

In the underclay-shale profiles below coals in the Pennsylvanian rocks, the clay minerals illite, kaolinite, chlorite, montmorillonite, and mixed-layer clays are spatially distributed downward with respect to the coal in a manner similar to the surface weathering profiles studied. The evidence suggests that the underclays may have been formed as a weathering profile on the under-lying shales.

Microfilm \$2.00; Xerox \$3.00. 60 pages.

**GAS CHROMATOGRAPHIC STUDY OF A CLAY  
MINERAL-ORGANIC SYSTEM.  
DETERMINATION OF ACTIVITY COEFFICIENTS  
AND HEATS OF ADSORPTION.**

(L. C. Card No. Mic 58-3785)

Carl Eugene Legate, Ph.D.  
Washington University, 1958

Chairman: Dr. William D. Johns

Gas chromatographic determination of heats of adsorption and activity coefficients of various organic adsorbates on montmorillonite indicate that (1) physical adsorption and/or aqueous solution is the principal mechanism by which montmorillonite-organic complexes form; (2) hydrocarbons have a higher mobility in sediments than polar organic constituents, especially in the early stages of diagenesis and (3) water is essential to the natural reversible formation of montmorillonite-organic complexes and may play an important role in the natural physical separation of organic sediments.

Gas chromatography offers an additional quantitative geochemical technique for studying relationships between "complex organic matter" and sediments. Its principal advantages lie in the possibility of studies of systems at near infinite dilution under carefully controlled environments. Parameters are measured which take due account of temperature of the system, vapor pressure of the adsorbate and adsorbate-adsorbate molecular interactions.

The technique of gas solid chromatography has been applied to the study of a clay mineral-organic system. An API standard clay mineral, montmorillonite, H-26 bentonite, Clay Spur, Wyoming, was used as the adsorbent. Ten organic compounds plus water were used as adsorbates. The organic compounds were n-hexane, cyclohexane, benzene, toluene, acetone, acetonitrile, 1-propanethiol, methanol, ethanol and n-propanol.

A suitable apparatus was designed and constructed and appropriate analytical techniques were developed for the determination of heats of adsorption and activity coefficients in a clay mineral-organic system.

The principles and thermodynamics of gas chromatography are discussed with special emphasis on the application of the principles of gas liquid chromatography to problems associated with gas solid chromatography as applied to the study of clay mineral-organic systems.

Heats of adsorption and activity coefficients of the various adsorbates on montmorillonite were determined over the temperature range of 40-90°C. The validity of the data is defended and their geologic significance discussed. The magnitude of the heat of adsorption data indicate that physical adsorption or aqueous solution occurs between the organic adsorbates and the oxygen surfaces of the montmorillonite lamellae or the water of hydration of the mineral respectively. Water of hydration was found to be essential to the natural reversible formation of montmorillonite-organic complexes. The activity coefficient data indicate that hydrocarbons and possibly mercaptans have an increased absolute volatility when over montmorillonite. This increase is shown to be greatest in the lower part of the temperature range studied. It is interpreted as meaning that hydrocarbons have a higher mobility in sediments than polar organic constituents, especially in the early stages of diagenesis. The relative activity coefficient data, when

viewed in the light of certain theories of solution, indicate that water may well play an important role in the natural physical separation of organic sediments.

Microfilm \$2.00; Xerox \$4.00. 74 pages.

**A REGIONAL CHEMICAL AND  
MINERALOGICAL STUDY OF SURFICIAL  
SEDIMENTS IN THE GULF OF MEXICO**

(L. C. Card No. Mic 58-2928)

Arthur Peter Pinsak, Ph.D.  
Indiana University, 1958

A chemical and mineralogical study of the Recent surficial sediments in the Gulf of Mexico was utilized to demonstrate regional chemical and mineralogical variations, which are the result of depositional environment or provenance or both, and the effect that these changes have on distribution of the clay mineral species. Semi-quantitative determinations of the clay minerals were made by X-ray diffraction analysis. Fluorescent X-ray spectrographic analyses were made for iron, manganese, titanium, calcium, and aluminum.

Distribution of aluminum, titanium, and iron in the Gulf of Mexico is directly proportional to distribution of clay material. Local variations in the relatively constant ratios of aluminum oxide to iron oxide (3.5:1) and to titanium oxide (34:1) and the ratio of titanium oxide to iron oxide (10:1) indicate that at least 85 percent of these materials in the Recent sediments are detrital. Virtual absence of elements other than calcium in the sediments on the West Florida and Campeche banks is evidence that drain-off onto these shelves is predominantly calcium salts. Abundance of clay minerals is inversely proportional to abundance of calcium.

The source of sediments is a major factor influencing clay mineral distribution in the open Gulf of Mexico. Regional distribution of illite, kaolinite, and montmorillonite indicates influx of these minerals in a detrital form.

Montmorillonite is the predominant clay mineral and is most abundant in the area receiving sediments directly from the Mississippi Delta. Presence of this mineral on the abyssal plain is a result of transport rather than alteration in situ, as rapid deposition and burial of sediments in the area seaward from the delta is not conducive to diagenetic alteration of degraded clays to montmorillonite.

Mixed-layer clay material increases with decrease in order of crystallinity of the clay minerals and is inversely proportional to abundance of clay material. High order of crystallinity of clay minerals in areas of rapid deposition indicates that adjustment of clay minerals takes place almost immediately upon introduction into the new environment. Abundant mixed-layer material on the western abyssal plain may be an intermediate metastable phase in the slow alteration of montmorillonite to illite.

Distribution of diagenetic expandable chlorite on the steep continental slopes suggests that its formation is rapid and is a function of change in environment.

Diagenesis of the clay minerals is influenced by 1) change of environment, and 2) length of exposure. Initial ion exchange, which is caused by a tendency to reach

equilibrium with a new environment, occurs so rapidly in the clay minerals that rate of sedimentation is a minor factor in comparison to environmental change. Slow alteration and adjustment toward a stable end state is most

complete in areas of slow deposition and extended exposure of the clay minerals to the environment.

Microfilm \$2.00; Xerox \$5.20. 101 pages.

## HISTORY

## HISTORY, MODERN

### HANOVER AND HANOVERIANS IN BRITISH POLITICS, 1714-1727

(L. C. Card No. Mic 58-2729)

Barbara Wolff Brandon, Ph.D.  
Duke University, 1958

Supervisor: W. B. Hamilton

The charge that during the reign of the first two Georges in particular the interests of Great Britain were sacrificed to those of Hanover has often been made but not generally substantiated. This dissertation is an investigation of those aspects of British policy and politics during the reign of George I which related to Hanover and the Hanoverians in an attempt to determine how great their influence was.

The chief of the Hanoverians was of course the King. George was thoroughly German and devoted to his electorate. The greater part of his life was spent in increasing the size and importance of Hanover. He became King of Great Britain after he was fifty, and through no efforts of his own. His position in Britain was limited to some extent by the Act of Settlement, and yet there was still much a King could do. George did not speak English; there is no indication that he enjoyed being in Britain; and he did not, on most occasions, take an active part in British politics. He of course chose his ministers; that was part of the function of the King, for there was no idea of a ministry's being determined by a parliamentary majority. So long as his ministers could provide him with his expected income and would support his foreign policy, however, George was willing to leave the everyday business of domestic politics to them. The King was most interested in foreign policy; in this field the monarch was the least restricted and furthermore it was one in which the interests of Hanover and Britain could be most closely combined. There is no question that British foreign policy, particularly that part involving northern and central Europe, was directed by the King between 1714 and 1727. George saw the chief international problems clearly, and during his reign Britain pursued a policy of close alliance with France and Prussia. Britain was also involved deeply in the closing years of the Northern War, primarily because her King was also Elector of Hanover.

George brought with him to Britain a large number of Germans. Several of these held positions in the Hanoverian government, others were his mistresses and personal servants. Naturally these Germans attempted to retain their positions of influence with the King and to advise him on British policy and politics as they did on Hanoverian

affairs. They were apparently successful for some years, though their actual influence with the King was less than they and others thought it. Finally George was forced to warn the Hanoverians not to meddle in British affairs, and during the latter half of his reign only those of the Germans who worked with the British were of any real importance.

For the British politicians, the period of George I's reign was one of adjustment and the emergence of new leaders. Through death and disgrace, the chief politicians of Queen Anne's reign disappeared, and the first part of George's reign was a time of experiment and change in politics. Only after 1720 did a real leader, in the person of Robert Walpole, emerge. A period of transition in politics is always difficult, and the complications of a foreign King and his foreign servants added to the problems of the British. They had to feel their way not only through the new political situation but also in dealing with an unknown and unpredictable sovereign.

Microfilm \$5.05; Xerox \$17.00. 395 pages.

### NEGRO SUFFRAGE AND POLITICS IN ALABAMA SINCE 1870

(L. C. Card No. Mic 58-2902)

Joseph Matt Brittain, Ph.D.  
Indiana University, 1958

This study, based primarily on private and official documents and on newspapers, describes the Negroes' role in, and influence upon, Alabama politics since 1870.

Enfranchised by the constitution drawn in pursuance of the first Reconstruction Act, the Negro--in uneasy union with the Carpetbaggers and Scalawags--helped to control Alabama for several years. The "white supremacists" had abstained from voting and had prevented the constitution from securing a favorable majority of all the registered voters, but Congress decided it had been adopted by a majority of the votes cast. By playing the three groups against one another, the "conservative democracy" was able to gain control in 1874 and to write a constitution favorable to "white supremacy." For the next sixteen years these "Redeemers" tightened their hold on the state by various legislative acts--a development that was made easier by the continual decline of the Republican opposition.

The decade of the 1890's was marked by a lessening of the Democratic appeal for the Negro vote. Intra-party difficulties were accentuated by the Populist movement; the "white supremacy" appeal was stepped up; Populism

was "absorbed" for the sake of unity; and the Negro was disfranchised in 1901. Property qualifications, as well as "understanding" requirements, were imposed on potential Negro voters.

Generally, the numerous requirements were not enforced against the whites, and fraud and intimidation were added to the legal restrictions against the Negroes. The most difficult obstacles to overcome were the boards of registrars in each county: they had almost unlimited power to exclude from the voters' lists anyone they desired to exclude. For the years from 1901 to 1930 only a handful of Negroes were registered to vote in Alabama, and even fewer were actual voters.

In the 1930's the Supreme Court began to undermine the right of the party to determine the voters in the primary, and in 1949 it struck down the Boswell amendment to the Alabama constitution. This amendment was then replaced with the Voter Qualification Amendment of 1951. The new measure omitted the "understand and explain" clause of its predecessor and required the Supreme Court of Alabama to prescribe a nondiscriminatory and uniform questionnaire to be filled in for all who applied for voter registration. To date, this measure has not been decisively tested in the courts. In spite of the maneuverings and restrictions of the "white supremacists," in the last twenty-five years about 40,000 Negroes have been added to the voters' lists. The number, however, is still far below what it was at the turn of the century.

Microfilm \$3.20; Xerox \$10.80. 245 pages.

**CANADIAN CABINETS IN THE MAKING: A STUDY IN  
THE PROBLEMS OF A PLURALISTIC SOCIETY:  
1867-1896**

(L. C. Card No. Mic 58-3214)

Sister Teresa Avila Burke, C.S.J., Ph.D.  
Columbia University, 1958

The Prime Ministers of Canada are bound by constitutional convention to represent the diverse interests of the Canadian people in their cabinets. The purpose of this study is to describe the origins and evolution of the representative nature of the membership of the Canadian cabinet during the period 1867-1896, and to set forth the problems involved in cabinet-making in a pluralistic society. The character and composition of the cabinets of this period have been delineated in detail. An attempt has been made to answer such questions as: to what extent did the cabinets represent the divergent provincial, regional, sectional, ethnic and religious interests of the country; what strength did each minister bring to the government; what compromises were Prime Ministers obliged to make in order to form workable governments; to what extent did these cabinets coordinate and conciliate the centrifugal forces of this federation. The growth of the two major political parties and their implications for the cabinet, and the interplay between federal and provincial politics as reflected in the cabinet, have also been considered.

Sir John A. Macdonald constructed his first cabinet with the intention of bringing together, irrespective of party affiliations, those men in favor of Confederation who represented majorities within the respective provinces to which

they belonged. The national coalition was short-lived but the principle of recruiting leaders for the cabinet continued. The basis of representation of the provinces was regional, with the thirteen ministers almost equally divided among three regions--5 seats for Ontario, 4 for Quebec and 4 for the Maritimes. Throughout this period of 1867-1896, each province clamored for representation in the cabinet; Ontario insisted upon the largest share of portfolios by reason of her superior wealth and larger population.

In addition to this regional and provincial representation, the cultural individuality of the French was safeguarded by three French Catholics, while the Irish Roman Catholics had at least one representative. The English-speaking Protestants of Quebec, a minority, had a representative from the Eastern Townships. Other Protestant sects and national strains in the population, such as English and Scotch, were also represented among the other members.

In the formation of his cabinet, Alexander Mackenzie, the Liberal Prime Minister, adhered to the precedents already formed. He complained that the exigencies of sectional representation deprived him of needed executive ability but his problem was rather his inability to obtain the best sectional representatives. The major limitations of Mackenzie's administration (1873-1878) centered about the personality of its Prime Minister and the poor organization of the provincial Liberal parties.

The success of Macdonald's second administration (1878-1891) lay not in the brilliance of his appointments but in the combination of a few capable ministers, a popular National Policy and his skill in handling men and political situations. However, his task became increasingly more difficult as the split widened between the ultramontanes and the "Cartier School" within the Quebec Liberal-Conservative party; and such issues as the Riel Affair, the Jesuits' Estates Bill and the Manitoba Separate Schools and Language question drove a wedge between the Orange wing of the party and the French-speaking and Catholic Conservatives. Macdonald managed to keep all these forces in marching order in the cabinet, but his successors were helpless in the face of these divisions.

The Conservative Prime Ministers of the years 1891-1896 faced the same importunities in cabinet-making and attempted to reach the same equilibrium of interests as had been the goal of the earlier premiers. By 1896, it was impossible for Prime Ministers to disregard these precedents in the formation of their cabinets.

Microfilm \$4.10; Xerox \$13.80. 320 pages.

**BRITISH POLICY AND OPINION ON WAR AIMS  
AND PEACE PROPOSALS, 1914-1918**

(L. C. Card No. Mic 58-2826)

Rodney Oliver Davis, Ph.D.  
Duke University, 1958

Supervisor: E. Malcolm Carroll

What was the relationship between public opinion and governmental policy in Britain during the first world war? This dissertation attempts to follow the interaction between the two in respect to war aims and peace proposals.

Particular attention is paid to Germany, since in many respects the war was considered to be primarily an Anglo-German struggle. Governmental policy was taken to mean those aims or proposals which were publicly expressed by authorized representatives of the government or those secretly pursued by the government which by one means or another became publicly known in whole or in part. Expressions of public opinion were sought in the newspaper and periodical press; in letters, pamphlets, and books written; in the debates of parliament; in meetings held; in resolutions passed; in movements and demonstrations organized; and in private diaries, papers, and memoirs.

There does not seem to be any substantial evidence to indicate that the British government or the British people as a whole wanted war or undertook any activity designed to bring it about. There were, however, a number of areas where Britain could stand to gain by participation in a successful war against Germany. It was, moreover, the German invasion of Belgium which served to bring an almost completely united Britain into the war and which presented her with a ready-made ideal. Restoration, reparation, the rights of small nations, and the reign of public law were all causes sufficiently vague and sufficiently ideal to enlist the support of a vast majority of the people. The Liberals were at first inclined to follow the governmental lead in dealing with war aims in terms of principles, while the Conservatives were more inclined to tie the aims down to the complete dismemberment of Germany or a reasonable safe facsimile thereof. The early opposition to the war arose generally from the ranks of Labor, but Labor on the whole supported it except for the Labour Leader and J. Ramsay MacDonald. Another source of opposition was the Union of Democratic Control which included both Liberals and Laborites in its ranks.

As the war progressed, numerous factors aided in the rise of peace sentiment: trench warfare, secret treaties, losses in men and material, coalition government, rising costs and rationing, and the Russian revolutions. Gradually more and more people added their voices to the pleas for peace or for a definitive and non-annexationist statement of aims. It was not until 1917, however, that a recognized leader, Lord Lansdowne, stepped forward. His "Peace Letter" was a signal for renewed efforts on the part of the advocates of peace. Lansdowne and other former ministers were an alternative to the government in power. They could appeal to the Liberals in opposition, to the leftists who wanted a peace of no annexations and no indemnities, and also to the extreme rightists who feared revolution and who were therefore willing to give Germany a free hand in the East in return for concessions and peace in the West.

The government responded to the pressure for a statement of war aims and the Prime Minister took a long step toward the repudiation of vindictive terms in his address to the Trades Union Congress in January, 1918. A dialogue soon developed across the channel and more reasonable statements about peace were forthcoming. Soon, however, came Brest-Litovak and Germany's March offensive. Britain seemed endangered and her people presented a united front. Talk of peace evaporated until the German offensive lagged. Attempts were then made to revive the peace movement, but the allied advance was too rapid. Reasonableness was lost in the flush of victory and with it the chances for a lasting peace.

Microfilm \$5.10; Xerox \$17.20. 400 pages.

## FRANCE AND THE VATICAN: THE BREAK IN RELATIONS, 1904

(L. C. Card No. Mic 58-2912)

Eloise Gompf, Ph.D.  
Indiana University, 1958

In the early years of the Third French Republic, the church, allied with the state by the Concordat of 1801, gained in prestige. Most French Catholics resisted republican institutions, and anti-clericalism became a feature of the Radical and Socialist party programs. A series of anti-clerical laws (1879-1889) attacked Catholic schools. Pope Leo XIII inaugurated a policy of acceptance of the Republic, but the Dreyfus affair brought the Radicals and Socialists closer together on a common program of anti-clericalism.

The Combes ministry (1902-1905) determined to guarantee the rights of the state under the Concordat with respect to the nomination of bishops. The resulting quarrel with the Vatican proved that in one of its core features the Concordat was not functioning effectively. Deciding to apply firmly the Law of Associations passed in 1901 to curb the influence of the monks in politics, the government closed all teaching establishments of monks and nuns, then refused to authorize the existence of all but five of the orders themselves. The new pope, Pius X, protested severely against Combes's bill to forbid teaching by all congregations of monks and nuns.

As part of the program of rapprochement with Italy, President Loubet prepared to visit the Italian monarch in Rome. Leo XIII had protested against a visit by the French president to the "spoliator" of the papacy. Unsuccessful attempts were made to find a way enabling Loubet to visit both at the Quirinal and the Vatican. Kaiser William II had been received by Leo XIII after visiting King Victor Emmanuel. The kaiser planned a trip to Italy to turn attention from that of Loubet, for he was well aware of the changed situation in international relations symbolized by the presidential visit.

The Vatican sent an immediate note of protest, which the French government declared inadmissible. After publication of the note and verification of its dispatch to other governments had been made, the French ambassador was instructed to leave the Vatican, but the cabinet decided to withhold a complete rupture of diplomatic relations.

Because the Vatican refused to surrender to the government's demand for the withdrawal of the summons to Rome of two French bishops, diplomatic relations were finally severed (July 30, 1904).

As the campaign against the religious orders was drawing to a close, pressure from the extreme Left impelled the ministry toward separation of church and state. The papal protest against the presidential visit and the citation of the two bishops brought a number of moderates into the separatist camp. Combes finally pronounced in favor of separation and laid his plan before the Chamber.

Separation and French representation at the Vatican were two distinct questions. Many hoped that diplomatic relations might be resumed in order to retain French protection of the Catholic missions in the East.

As the abrogation of the Concordat was being accomplished, the ministry fell. Separation was consummated by Combes's successor, but the incidents occurring during

the Combes ministry had produced the climate of opinion to allow it. Microfilm \$2.95; Xerox \$10.20. 227 pages.

### THE CAUSES OF THE WAR OF 1812

(L. C. Card No. Mic 58-2917)

Reginald Horsman, Ph.D.  
Indiana University, 1958

The confusion concerning the origins of the War of 1812 has stemmed basically from the lack of attention paid to the position of England in the causes of the conflict, and from the overemphasis that has been placed on "western expansionist" factors. America went to war in 1812 primarily in reaction to British maritime policies, which were dictated to a great extent by European considerations. From the British point of view, it was essential to prevent American commerce from aiding France, and it was essential to prevent the wholesale desertion of seamen to the Americans. If possible, England wished to avoid war with America, but not to the extent of allowing her to hinder the British war effort against Napoleon. America's position was made worse by the fact that for most of the period from 1803 to 1812 political power in England was held by a Tory group that was pledged not only to the defeat of France, but also to the maintenance of British commercial supremacy. Commercial jealousy of America thus combined with the necessity for total war against France to produce a restrictive British maritime policy.

The American protest at British maritime policy can be traced as a continuous process from at least 1805 to 1812. Bitterness against England had become extreme by 1807, and the five year delay in the declaration of war is explained primarily by the determination of Jefferson and his followers to attempt economic coercion before embarking upon an extremely dangerous war. The trial and failure of economic resistance made its alternative--war--even more difficult, for the Embargo produced both economic turmoil and political dissention. Yet, the failure of economic coercion made war, or absolute submission, the only alternatives, and the latter presented more terrors to the recent colonists. The main support for war in the years from 1809 came from those areas--the West and the South--that had supported economic coercion, and that were suffering most from British restrictions at sea. The commercial classes of America were making ample profits from the wartime carrying trade, but the producers, who looked longingly at the export market, were suffering a commercial depression in the years before 1812.

Though the concern at the Indian problem on the Northwest frontier added to the irritation against Great Britain, there seems no reason to suppose that this was either the basic cause of war, or even the factor that finally impelled America into open hostilities. Even had there been no Indian problem, it seems likely that America would have gone to war in 1812. The conquest of Canada was a means of waging war, not a reason for starting it. America in 1812 was acting essentially in reaction to British maritime policy. This British policy, though influenced by jealousy of American commercial growth, stemmed basically from the necessity of waging total war against France. Had there been no war with France, there would have been no

Orders in Council, no impressment, and, in all probability, no War of 1812.

Microfilm \$5.35; Xerox \$19.00. 420 pages.

### JOSEPH GALES, THE NATIONAL INTELLIGENCER, AND THE WAR OF 1812

(L. C. Card No. Mic 58-3235)

Howard F. Mahan, Ph.D.  
Columbia University, 1958

In 1810 Joseph Gales Jr. became editor of the Washington, D.C., National Intelligencer, semiofficial newspaper of the Madison Administration. Though only twenty-four, Gales was well qualified. His father was a newspaper editor, and his mother a writer. He had graduated from the University of North Carolina, and the elder Gales had trained him in the craft of printing and in stenography. He had reported Congressional debates for three years and assisted with editorial duties before becoming the Intelligencer's editor and owner.

The Intelligencer had been founded in 1800 by Samuel Harrison Smith, who made it the best source of Washington news. It also became recognized as the newspaper voice of the Jefferson and Madison Administrations. It furnished political leadership for some 150 Republican presses and tended to arouse opposition from approximately the same number of Federalist newspapers. These partisan organs played an indispensable role in the political process, and the power of the Intelligencer to influence public opinion represented a vital function of political leadership.

After purchasing the Intelligencer Gales wrote vigorously against French and British violations of United States neutral rights at sea. He said the United States could either submit to aggression or resist by force. This was also the attitude of President Madison and later of Secretary of State Monroe, as Gales's Diary and other evidence shows.

When the British in the summer of 1811 began to blockade American harbors, interfere with coastal trade, and impress American seamen, a universal protest rang out. But the newly appointed British minister in Washington offered little but threats, so Madison and Monroe decided to arm for war. Gales then came forward with officially inspired editorials, asking whether commerce was to be abandoned or fought for, and whether the Revolutionary spark was dead. Two months later at the opening of Congress in November, the War Hawks met for the first time. According to Gales, Secretary of State Monroe led the War Hawks, sustaining the drive for war, rallying Congressmen, writing Intelligencer editorials, and providing the House foreign relations committee with its war manifesto. Thus, the war was precipitated by the executive, following a policy of resistance to British maritime aggressions.

During the war of 1812 the Intelligencer evaluated events according to the Administration's basic aim of resisting "practical injuries." When Britain gave assurances that these would cease, Gales said, the Administration would make peace. Britain, however, refused to yield, even after the end of the war in Europe removed its reasons for violating American rights. Britain sought

vengeance. But American armies repulsed two British expeditions, at Baltimore and Lake Champlain, and crushed a third at New Orleans. When news of the Ghent peace treaty arrived, the *Intelligencer* exulted, asserting that the United States singlehandedly had held Britain to a draw. It said the national honor had been preserved, Administration policy justified, and republican government vindicated.

The War of 1812 also secured the position of Gales as chief editor of the Republican party. During the conflict he had taken William Winston Seaton, his brother-in-law, into the firm as a partner, and the two editors had established a *Daily National Intelligencer*. They had maintained the high principles of journalism established by Samuel Harrison Smith, reported both sides of the war news and Congressional debates, and had constantly advocated freedom of the press despite intense Federalist attacks against the war and the Administration. The partnership of Gales and Seaton thus begun lasted for nearly fifty years, during which the *Intelligencer* remained a powerful and principled political journal.

Microfilm \$4.80; Xerox \$16.00. 373 pages.

#### JAMES OLIVER AND THE OLIVER CHILLED PLOW WORKS

(L. C. Card No. Mic 58-2925)

Douglas Laing Meikle, Ph.D.  
Indiana University, 1958

This study of James Oliver, prominent agricultural implement manufacturer, traces his life from his birth in the Scottish lowlands in 1823 until he had reached the great years of fulfillment before his death in 1908. James Oliver was the youngest in a large family whose life in Scotland was barely above the subsistence level. An elder brother emigrated to America and the rest of the family followed, settling first in New York state before moving to Indiana. Oliver held a variety of jobs, among them farm choreboy, swineherd, and deckhand on a river boat, before he learned the moulding trade.

In 1855 he brought into a small foundry located on South Bend's West Race; his quarter share in the business was purchased for less than one hundred dollars. Among the adversities he faced in those early years were fires, floods and lack of business. He persevered and finally became sole owner of the foundry. The products turned out included iron kettles, wagon skeins, cast iron columns, window weights and miscellaneous castings. As business improved Oliver turned to plow-making.

James Oliver's first significant step towards success came in 1868 when he invented a process to chill the iron so as to funnel off the damaging gases from the mould so that the finished iron product would be smooth and free from all imperfections. The plow points and mouldboards turned out by this chilling process would wear better and would scour in any type of soil and save the farmer the laborious task of scraping the mouldboard at the end of each furrow. The superiority of chilled iron soon became apparent and the sale of Oliver plows increased significantly. This made possible the complete concentration on plow-making and all other lines of iron castings were discontinued.

It was not long before the small foundry became inadequate and Oliver determined to build a new large plow factory on the outskirts of South Bend. By 1875 the move had been made and with improved facilities more plows were turned out. So rapid was the growth of business that scarcely a year passed that some improvement or addition was not made to the original plant.

Success in the domestic market prompted the Olivers to sell plows in other parts of the world. Oliver plows were first marketed abroad in Scotland and soon were used in many countries, including France, Algeria, South Africa, Australia, throughout Latin America and in the Philippines. The success of Oliver plows in foreign lands rivalled that of their success in the United States. Company designers were constantly experimenting to produce a plow for every type of soil.

When James Oliver died at the age of 84 he had accomplished what he had set out to do. His plow was accepted the world over as one of the best made; the city of South Bend had been improved through his civic-mindedness; his factory in South Bend was increasing its capacity yearly in the face of increased demands for its products; and he had earned the deep respect of his fellow men. Perhaps most gratifying to James Oliver was the knowledge that his son, Joseph Doty Oliver, always his right hand, would continue to operate the Oliver Chilled Plow Works as capably as had its founder.

Microfilm \$7.40; Xerox \$25.80. 583 pages.

#### JOSEPH E. BROWN AND THE NEW SOUTH

(L. C. Card No. Mic 58-2834)

Derrell Clayton Roberts, Ph.D.  
University of Georgia, 1958

Major Professor: Ellis Merton Coulter

Joseph E. Brown's Reconstruction and New South career was concerned with political, economic and philanthropic matters.

Politically, he was Governor of Georgia until June, 1865, when he resigned after a provisional governor was appointed by President Andrew Johnson. After a short period of imprisonment, he returned to Georgia and advocated the acceptance of the President's plan of Reconstruction. By 1867, the President's power waned and a Radical Congress passed new Reconstruction laws to which Brown counseled acquiescence. During this period, he joined the Republican party, made an unsuccessful bid for the United States Senate and became Chief Justice of the Georgia Supreme Court from 1868 to 1870. Then in 1872, he joined the Liberal Republican movement and by 1876, was back in the Democratic Party. When John B. Gordon resigned as United States Senator in 1880, Brown was appointed to serve until the next election. He was elected and served through another election until 1890.

Brown's major interest during this period was in amassing a fortune. His early life was spent on a farm and he continued this interest by buying agricultural land in Georgia as well as in other states. In 1870, Brown became president of a company that leased the state owned Western and Atlantic Railroad. The leasing company

underwent several legislative investigations, but held the lease until 1890. Near the Western and Atlantic, in Northwest Georgia, he bought and leased a large amount of land where coal and iron mines were developed with the help of convicts leased from the State of Georgia.

While Brown made a large amount of money, he gave freely of his time and money to philanthropic causes. He gave \$50,000 to the University of Georgia and a like sum to the Southern Baptist Theological Seminary, as well as smaller amounts to other schools and churches. When the Atlanta public school system was established in 1869, Brown was appointed president and served for several terms. For many years, he served as a member of the Board of Trustees of the University of Georgia. An active Baptist, he played an important part in the life of his church and served terms as Vice President of the Southern Baptist Convention.

For the last four years of his life, Brown was inactive because of failing health. Nevertheless, his death in 1894 ended a full life.

Microfilm \$4.40; Xerox \$14.80. 344 pages.

#### THE FINANCIAL AND ADMINISTRATIVE ORGANIZATION AND DEVELOPMENT OF OTTOMAN EGYPT (1517-1798)

(L. C. Card No. Mic 58-3764)

Stanford Jay Shaw, Ph.D.  
Princeton University, 1958

The principal objective of Ottoman rule in Egypt was to secure the exploitation of its wealth and the diversion of a maximum portion of the resulting revenues to the Treasury of the Porte in Egypt.

PART I. The wealth of Egypt came principally from the cultivation of the land (CHAPTER I) and the exploitation of urban industry, trade, and commerce (CHAPTER II). Over the principal sources of wealth were established Muqata at, whose holders were required to supervise their exploitation and to deliver to the Treasury its share of the proceeds.

PART II. The revenues of the Imperial Treasury at Egypt were supposed to be expended to fulfill the obligations of the Porte in Egypt (CHAPTER I) and for the Pilgrimage and the people and institutions of the Holy Cities (CHAPTER II) and to provide for the purchase of commodities and other supplies needed by the Porte from Egypt (CHAPTER III).

PART III. The surplus of the revenues of the Imperial Treasury of Egypt over its expenditures were supposed to be dispatched annually to the Porte as its cash Irsaliyye-i Hazine, or "Treasure which was sent" to the Sultan.

To carry out this objective, there was established an Ottoman hierarchy of administration, which was directed by the Vali of Egypt, representing the Porte, and carried out by a Mamluk hierarchy of officers and soldiers, who composed the locally-based ruling military class of Egypt. Over the centuries, the Mamluk hierarchy was able to achieve complete authority in Egypt and to divert the entire proceeds of the Muqata a system for the profit of its

members. While the revenues of the Treasury increased almost one hundred per cent during the three centuries of Ottoman rule, the total revenues produced from the wealth of Egypt increased by an even greater amount, and the bulk of that increase was diverted to the direct profit of the members of the Mamluk hierarchy, entirely outside the scope of the Imperial Treasury and its Muqata a system. At the same time, the expenditures of Treasury funds were, for the most part, diverted to the profit of the members of the Mamluk hierarchy, while the burden of Imperial obligations in Egypt and the Holy Cities and of purchases for the Porte in Egypt was shifted to the Irsaliyye-i Hazine funds, from which little remained for shipment to the Porte. Since the Porte found itself unable to restore the operation of this system for its own profit and objectives, it entirely abandoned it to those who controlled the Mamluk hierarchy and secured in its place a Hulvan income composed of charges sent to it by the victors in the Mamluk struggles for power in return for Ottoman recognition of the legitimacy of their seizures of the possessions of the vanquished.

PART IV. The Valis of Egypt were provided with revenues from Imperial Possessions set aside especially for them in return for their service in Egypt (CHAPTER I). In return for these revenues, they owed taxes to the Treasury and to the Porte. In addition, they were required to accept the burden of Treasury expenditures for which normal revenues lacked. (CHAPTER II).

PART V. The finance and administration of Ottoman Egypt was centralized and directed in the Imperial Treasury of Egypt, staffed by a corps of Efendis and divided into departments, each of which was responsible for registering and accounting certain revenues and expenditures of the Treasury and for supervising the activities of certain other departments of the Treasury.

Microfilm \$7.70; Xerox \$26.80. 608 pages.

#### MEN, MONEY, AND POLITICS: THE SPECIE RESUMPTION ISSUE, 1865-1879

(L. C. Card No. Mic 58-3252)

Irwin Unger, Ph.D.  
Columbia University, 1958

This is a study of business attitudes toward post Civil War currency problems and of businessmen's influence on the course of federal monetary legislation from 1865 to 1879. The study focuses on the specie resumption struggle, though some attention is given to the related problems of free banking and repayment of the wartime debt where they impinge on the resumption question. An attempt has been made, in the course of a detailed history of Reconstruction currency legislation, to test the thesis advanced by Charles A. Beard and others that the return to gold payments was enacted by the Republican party at the behest of the dominant postwar business interests.

Actually, diversity rather than uniformity characterized the financial opinions of businessmen between 1865 and 1879. In general, merchants of the eastern seaboard cities favored a rapid return to specie, since the paper standard introduced an element of uncertainty into foreign

trade transactions. Merchants of the interior, however, already handicapped by inadequate credit and banking facilities, often resisted gold payments. In the nation's more mature industries—among the cotton textile magnates of New England, for example—sound money sentiment predominated. In contrast, ironmasters, railroad promoters, and land speculators—in general, men involved in the more rapidly growing segments of the American economy—feared the deflation of prices and profits which they believed must accompany resumption.

Superimposed on this fundamental pattern were the variations produced by business fluctuations and the changing fortunes of individual businessmen. During the recession that accompanied the contraction policy of Treasury Secretary Hugh McCulloch in 1866-1867, business groups previously friendly to sound money assailed the Secretary's measures to promote resumption. During the railroad boom of the early seventies most businessmen defended the existing irredeemable paper system. After several years of depression in the later seventies, however, business opinion once again shifted to a sound money position.

The diversity of business opinion partially answers one question raised by this study: Did the postwar business interests, through control of the Republican party, dictate the currency legislation that brought the nation to specie on January 1, 1879? Even at the end of the greenback period a sizable body of businessmen opposed resumption, and, although soft money sentiment declined after 1877, there was never a clear business mandate for specie payments.

During the paper money era the Republican party was not the passive tool of business pressure groups in financial matters. When, during financial crises, businessmen combined to demand some specific item of monetary relief, Republican politicians could respond with alacrity. But when businessmen disagreed, they were often disregarded. Thus, during the brief 1866-1867 recession, when a Congressional coalition of western and Pennsylvania Republicans withdrew McCulloch's contraction power, and again in 1873, when a similar sectional alignment passed the Inflation Bill, Republican politicians complied with what seemed the united voice of American business. At other times, however, the need for party unity determined financial legislation. The Resumption Act of 1875, for example, under which the nation achieved gold payments, was designed primarily to prevent a schism in party ranks that would have endangered Republican Presidential prospects.

Post Civil War politicians, often pictured as eagerly solicitous of business needs, in reality frequently strove diligently to avoid taking a stand on resumption. Measures like the June, 1874, Banking Act and the Resumption Act itself were compromises designed to appease both hard and soft money opinion and remove the disruptive currency question from American politics.

The Reconstruction currency controversy is, then, characterized by business heterogeneity, not uniformity; by a frequently autonomous, rather than a subservient, party system. Microfilm \$5.00; Xerox \$16.80. 390 pages.

# JESSE DAVID BRIGHT: MASTER POLITICIAN FROM THE OLD NORTHWEST

(L. C. Card No. Mic 58-2945)

Wayne J. Van Der Weele, Ph.D.  
Indiana University, 1958

Jesse David Bright was born December 18, 1812 in Norwich, New York, but at an early age he was moved to Shelbyville, Kentucky and then to Madison, Indiana. There young Bright grew to manhood, studied law, and was admitted to the bar in 1833. He never attained any eminence in the legal profession; politics became and was to remain his ruling passion.

Bright's first elective office was that of probate judge of Jefferson county; next he was appointed United States Marshal for Indiana; and in the fall of 1841 he won a seat in the state senate. Two years--and an exciting campaign--later he was Lieutenant-Governor presiding over an evenly-divided senate and thus wielding an unusual influence. In December, 1845 he was chosen United States Senator.

Bright's senatorial career was a lengthy one--he was re-elected in 1851 and in 1857--but he rarely if ever rose to the level of statemanship. Content to leave to others the business of public oratory, Bright made his voice heard in conferences, committees, cloakrooms, and social affairs as he had done with such singular success while a member of the state senate.

Bright maintained a firm control of the Hoosier Democratic Party for a number of years, but opposition to him was to center around Joseph Wright, governor from 1849 to 1857, and Stephen A. Douglas, senator from Illinois. Bright's efforts in behalf of Buchanan in 1856 and patronage control were among the factors that led to a bitter feud between the two senators. Bright's stand in the Le-compton crisis and his unyielding opposition to Douglas proved unpalatable to his constituents, and he soon stood virtually alone. The Hoosier boss ignored the signs, organized a Breckinridge ticket in 1860, stumped the state for the southern faction of the party, and sacrificed the last vestige of control over political affairs.

Bright's refusal to support a policy of coercion against the seceded states--even after war had begun--fostered the conviction that he was disloyal. A letter addressed to Jefferson Davis as "President of the Confederation" served as a pretext for action that resulted in the Hoosier's expulsion from the Senate on February 5, 1862.

A few feeble attempts were made by Bright to regain his power in Indiana, but he soon gave up and moved to Kentucky where he had long held land and slaves. From 1866 to 1871 he was a representative in the Kentucky legislature but rarely answered a roll call. Most of his years were spent in managing his landholdings in Indiana, Kentucky, and Wisconsin and his interests in West Virginia coal mines. For more advantageous management of the mines, he moved to Baltimore in 1874. There he died on May 20, 1875. He was survived by his wife Mary, one son, and five daughters.

Microfilm \$4.20; Xerox \$14.20. 326 pages.

## THE JEWS OF PORT CHESTER

(L. C. Card No. Mic 58-2825)

Walter P. Zand, Ph.D.

Yeshiva University, 1956

The Jews of Port Chester is a social history of a small American Jewish community.

The data for the study was derived from many sources - older residents, newspapers, residential directories, organization records, public documents, police reports and birth certificates.

Jews first settled in Port Chester in the eighteenth century. They numbered 2235 in 1950, representing ten percent of the total population.

From a handful of Jews in retail enterprises, the Jewish labor force grew to 813 in 1950 and was represented in all

occupational endeavors. Their economic history was marked by much change. Most significant was the increasing proportion of Jews in the professions and manufacturing. Many Jews prospered over the years.

Port Chester Jews differ today from the early settlers in the greater social distance between them, their modified religious attitudes and practices, and their integration into the total community.

Jewish group life was expressed in various Jewish communal organizations which had religious, welfare, educational or ideological objectives but also met basic emotional needs of security, companionship and recognition.

Port Chester Jewry became an integral part of America as their involvement increased in the economic, civic and political life of Port Chester.

Microfilm \$4.55; Xerox \$15.20. 354 pages.

## HOME ECONOMICS

ATTITUDES OF WOMEN REGARDING GAINFUL  
EMPLOYMENT OF MARRIED WOMEN

(L. C. Card No. Mic 58-2789)

Hortense M. Glenn, Ph.D.

The Florida State University, 1958

The general aim of this study was to investigate attitudes of married white women regarding married women working outside their homes. It sought to extend existing knowledge concerning how attitudes vary between younger and older women, among women of differing social classes, among women of differing educational backgrounds, and between those who are and those who are not gainfully employed.

The following null hypotheses were tested:

1. Social class, age, education, and employment status are independent of subjects' attitudes toward gainful employment of married women when the presence or absence of children in the home is considered.
2. Social class, age, education, and employment status are independent of subjects' attitudes concerning whether a wife should
  - a. work if her husband does not approve
  - b. work to make it possible for the couple to marry earlier than would otherwise be feasible
  - c. want to have some financial independence by working to have money of her own.

A 20 per cent random sample of married homemakers (N=247) in a small town in South Georgia served as subjects. Social class membership was determined by the McQuire-White Index of Social Status (Short Form). A study of the literature revealed that the reasons commonly given for a married women entering the labor force could be grouped into three classifications: (1) economic reasons, (2) dislike of housekeeping and/or preference for the occupation in question, and (3) desire to use training or

occupational skills because of social need, or the feeling that training was wasted if not followed by gainful employment.

The interview schedule was designed to identify attitudes of respondents toward gainful employment of women for such reasons when they have (1) no children, (2) children under school age, (3) grade school age children, or (4) high school age children. Data were collected by personal interview using a pre-tested schedule. The Chi-square test was used to determine whether or not responses of subjects were independent of social class, age, education, and employment status. A probability of 5 per cent was accepted as the criterion of significance.

The majority of subjects indicated approval of a married woman, without children, working if she wishes and if her husband does not object; they believed that her work should contribute to family goals and did not regard favorably employment for purely personal reasons or to establish financial independence of her husband. The great majority of respondents evidenced disapproval of outside employment for mothers of small children. When the children were older, there was more tolerance of employment, however, these subjects had more reservations concerning a mother of high school age children working than was true when considering women with no children.

Substantial differences in approval or disapproval of employment were not found among subjects differing as to social class, education, and age. A strong relationship was found between employment status and attitudes expressed. More subjects who were employed full time than full-time homemakers were favorable to married women working, to a statistically significant degree, for most of the reasons considered.

All of the null hypotheses listed above were held as tenable with one exception: The strong association between employment status and the subjects' attitudes made it possible to reject the null hypothesis that employment status is independent of the attitudes of these subjects.

Microfilm \$2.00; Xerox \$4.60. 89 pages.

PERFORMANCE OF RESIN TREATED AND  
NON-RESIN TREATED PERCALE UNDER  
CONTROLLED AND UNCONTROLLED LAUNDERING  
METHODS AS RELATED TO  
CONSUMER SATISFACTION

(L. C. Card No. Mic 58-2790)

Jewel Golden, Ph.D.  
The Florida State University, 1958

The purpose of this study was to determine the performance of sixty-nine resin treated and non-resin treated cotton percale skirts under controlled and uncontrolled laundering methods, and to relate the laboratory findings to the use practices and satisfaction of the subjects.

The investigation was based upon the general hypothesis that cotton percales having specified resin finishes will, during the "primary use of the garment," require less time for upkeep and will give greater consumer satisfaction than non-resin treated percale.

The test fabrics were three 80-square cotton percales, which consisted of resin finishes for two and a regular starch-sanforized finish for the third. The test garments were gathered skirts. The subjects were (1) 20 pre-teenage girls; each wore a set of 3 skirts, (one skirt from each of the 3 test fabrics) over a period of 20 weeks, and (2) their mothers who laundered the skirts by their accustomed methods. The mothers kept records of procedures used and the exact time required for ironing each skirt after each of ten launderings. Two additional pre-teenage subjects wore skirts which were laundered in the laboratory by controlled methods along with one set of skirts which was never worn.

Swatches of fabric taken from concealed panels in all skirts provided worn and laundered fabrics for routine laboratory tests after 1, 3, 5, and 10 launderings.

Subjective evaluations of the appearance of the home laundered skirts indicated that irrespective of laundering methods used, there was a smoother appearance for the two resin treated cottons than for the non-resin treated control fabric. At the beginning of the study, type I fabric, which was resin treated for minimum care, gave a smoother appearance than type II, which was treated for wrinkle resistance only. With later launderings subjective ratings did not differentiate the two resin finishes. However, laboratory tests showed wrinkle recovery angles below the generally accepted minimum for wash-and-wear ( $220^{\circ}$ - $240^{\circ}$ ) for type II fabric by the end of the 5th laundering. Type I was well within the minimum after 10 launderings.

In only 5 per cent of the total of 600 home ironings was a skirt considered wearable without any pressing. This is contrary to the interpretation of what is wearable without ironing as indicated in the reports of recent laboratory researchers.

Processed data indicated that there was a highly significant difference, as measured by the "t" test, in ironing time between skirts made from the resin treated and non-resin treated fabrics. The time required for ironing resin treated skirts was reduced 20 to 40 per cent over non-resin treated skirts during 10 launderings.

Interview results, along with the laboratory data, supported the hypothesis that resin treated fabrics require less time for upkeep and give greater consumer satisfaction than non-resin treated fabrics.

Microfilm \$2.00; Xerox \$6.60. 136 pages.

LANGUAGE AND LITERATURE

LANGUAGE AND LITERATURE, GENERAL

THE GITANO IN SPANISH LITERATURE

(L. C. Card No. Mic 58-2250)

Carl De Wendler-Funaro, Ph.D.  
Columbia University, 1958

This study has traced the course of the Gitano in Spanish literature since his advent in the Peninsula in 1447. The early recognition, the growth in importance of the type, and the development of the figure through the five hundred years of the Gitano's sojourn in Spain are followed with examples to show his gradual acceptance. The relationship of this romantic type, whose origin was Spanish, to the literatures of Germany, Holland, France, and England has been considered in detail and its importance in these literatures evaluated.

A definition and description of the Gitano as evidenced in the various periods of Spanish literature from the autos and comedias of the sixteenth century through the idealized characters of Cervantes and others in the seventeenth century, with a consideration of the Gitano in the picaresque

novel; his influence in the life and literature of the eighteenth century, and the part played by the Gitano in the Romantic movement, and, finally, the realism of the modern period are all dealt with in detail.

This study has been treated chronologically with a consideration of the role given the Gitano in the drama, novel, and poetry throughout the various literary periods and movements.

The development of the idealized type reached its zenith with Cervantes and his figure, Preciosa. The universal appeal of his heroine gave rise to a great number of heroines, both in Spain and abroad, who as Esmeralda, Carmen, Mignon, or Preciosilla perennially recur in literature.

The various treatments of the Gitanos are described, starting with the unassuming lisping and fortune-telling Gitana in the auto-sacramental. Followed by the singing, dancing, foreboding, and pilfering characteris, they soon assume a more definite role, and reach a high point through their adoption as legitimate figures upon the center of the stage, and are deemed worthy of being novelized by Cervantes. The importance of the Gitano is fully acknowledged and he appears more frequently in the picaresque novels and the drama. Few great writers neglect his presence or

fail to recognize his value as a literary figure. In the barren seventeenth century, too, his effect on the life and language of the native is important though he appears but seldom in literature.

In the early nineteenth century, the Gypsy, a natural element for the Romantic movement, assumes a grandiose form in *El trovador* where, in the person of Azucena, the Gitana will long stand forth as an unforgettable character.

In modern literature, the Gitano is presented in all his sordid realism, though there are vestiges of the romantic, glorified type which strongly remind one of the idealization of Cervantes' figures. The poetry of the nineteenth century is especially partial to this romantic element, though even in the drama of this period the Gitano serves as a source of interest. The most divergent modern poetry of Garcia Lorca is original in its presentation of the Gitano, lacking the conventionalized style of both idealized and realistic types of the past.

The universal interest in the Gitano is shown to have had its roots in Spanish literature and its course has been traced in the many works considered. The importance of the Gitano is proved by the numbers of authors who deemed the Gitano worthy of their interest, and through the great debt the literatures of Germany, Holland, France, and England acknowledge to Cervantes for his creation of the Gitano figure in literature.

Microfilm \$4.15; Xerox \$14.00. 322 pages.

#### A STUDY OF GERMAN LANGUAGE INSTRUCTION IN CERTAIN MAJOR PUBLIC SECONDARY SCHOOLS IN MICHIGAN FROM 1900 TO 1925

(L. C. Card No. Mic 58-3660)

William Dudley Fuehrer, Ph.D.  
University of Michigan, 1958

This study was conducted for the purpose of ascertaining the status of German language instruction in Michigan --to what extent it was a part of the high school curriculum, the nature of instruction in the language, and the degree to which certain sociological factors, operative in an educational milieu--including the severe impact of World War I--affected the status of the language.

In the search for school records and other pertinent data, questionnaires were employed based upon an approximate 20 per cent of Michigan high schools and an approximate 40 per cent of prominent state public and private libraries. Records of the University of Michigan Bureau of School Services high school inspection reports, the United States Bureau of Education reports, and the annual reports of the state superintendents of public instruction provided statistical data. A systematic treatment of two questionnaire studies done during 1912-14 form a basis for data concerning both the prevalence of German and the nature of instruction in the course.

Early investigation revealed the great extent to which German was taught (74 to 92 per cent in city schools) and the prominent role which high concentrations of people of German birth and extraction played in determining the prevalence of German in the high school curriculum.

Consequently, a historical survey of these people, their immigrant background, and their contributions to the social

and educational life of the state, including the German-language press, was undertaken

Other factors affecting curriculum, personal and impersonal, are treated in their relation to the course in German. An account of the extreme impact of World War I, with the resulting abandonment or abolishment of German language instruction, and an analysis of postwar efforts toward rehabilitation are further aspects of the study.

In conclusion, a first fact is that the prevalence of German language instruction was determined by the following factors: a strong Germanic element in the state's population and culture, the almost universal role of Germany as a leader in higher learning and as a formulator of educational structure, the efforts of the University of Michigan Department of German in preparing teachers of German for the secondary schools, and the maintenance of close liaison with these schools. A second fact is that the violent effect of World War I almost destroyed German language instruction in the state and disrupted the normal operation of other factors affecting curriculum. A third fact is that in the altered postwar socioeconomic situation languages were becoming secondary and that the little success which German had could be largely attributed to the personal efforts of high school administrators and faculties to create interest in German in the face of a lack of interest by pupils and parents, and the lack of activity of any interested pressure groups. Microfilm \$3.30; Xerox \$11.20. 254 pages.

#### RUDYARD KIPLING: A STUDY OF HIS THOUGHT AND SOCIAL CRITICISM

(L. C. Card No. Mic 58-2926)

Stanton Millet, Ph.D.  
Indiana University, 1958

As Kipling intended, his prose and poetry, dominated by the three themes of locale, the strata of society, and the origins of customs and institutions, constituted a critical survey of the British Empire. The philosophy which informed this survey was romantic primitivism based on a distrust of civilized society and a corresponding idealization of the noble savage.

Kipling attacked the art, religion, and government of Western society. Since art was to him "the record of the Tribe," a knowledge of nature and of the active man's achievements seemed indispensable to its production and appreciation, but such knowledge was impossible to the city dweller. Kipling's religion was similarly based on action: if one acted, he could give his life meaning in an indifferent universe; if he acted according to certain simple virtues, he could achieve a godlike existence. But the sheltered man, protected from knowledge of work, pain, or death, reassured by the unreasonably abstract doctrines of his church, and directed by a superficial moral code, had lost contact with the sources of religion as well as the sources of art. Finally, Kipling believed that the ideal government (he postulated three forms, culminating in an international oligarchy) should limit itself to creating an environment in which man could develop his own abilities through work. But American democracy and British liberalism, both attempting to create Utopia through legislation, seemed to him to obscure man's perception of natural

virtue, vitiate his desire to work, and thus make it impossible for him to accomplish his own salvation.

In opposition to the hollow, sheltered, civilized man, Kipling created four stereotypes of the noble savage: the soldier or laborer, the subaltern, the civil servant, and the aristocrat. These characters, who share a deep love of nature, a keen sense of humor, courage, humility, and deep devotion to their work, represent four degrees of Kipling's "Law," a code of conduct which he defined most clearly in *The Jungle Books*.

As means of propagating his "Law," Kipling preached three theories of discipline: (1) military discipline, formal and informal, was based on ideals of sacrifice and "balance, proportion, perspective"; (2) the discipline of craftsmanship was governed by a vision of perfecting one's craft; (3) the discipline of Sussex was service to the land and its traditions. Each theory implied specific duties and allegiances which, taken together, would govern almost every aspect of one's life, but Kipling was not proposing to eliminate individuality. He believed, on the contrary, that one could only achieve true freedom when he was guided by the discipline of an ideal.

Analysis of Kipling's thought and social criticism forces us to redefine the terms *Tory* and *imperialist* as they apply to his writing. While he accepted the conventions of his society and glorified the Empire, he was not a blind defender of the status quo. His imperialism was not exploitation but the establishment of "The Law," the order necessary for true progress.

Microfilm \$3.00; Xerox \$10.20. 229 pages.

THE HUNTING OF LEVIATHAN:  
SEVENTEENTH-CENTURY REACTIONS TO THE  
MATERIALISM AND MORAL PHILOSOPHY  
OF THOMAS HOBBS

(L. C. Card No. Mic 58-3239)

Samuel I. Mintz, Ph.D.  
Columbia University, 1958

Hobbes was the *bête-noire* of his age. His books were banned and publicly burnt, and the ideas which Hobbes expressed in them in his lucid and potent style were the object of more-or-less continuous hostile criticism from 1650 to 1700. This study is an examination of the contemporary reaction, with special reference to the attacks made on Hobbes's materialism and moral philosophy.

Hobbes's contemporaries reviewed his materialism, his scepticism of witchcraft, his determinism, his ethical relativism, his egoistic psychology. In everything they found him a prime example of the philosopher whose doctrines are wrong in themselves as well as dangerous to public morality.

His materialism was wrong, the critics maintained, because it could not support a theory of consciousness. If we accept Hobbes's view of mind as a mere mechanism, not animated by spirit, how, the critics asked, can we account for memory and reasoning and awareness? If mind is matter in motion, why are inanimate objects mindless? These questions were posed by Stillingfleet and Tenison, among others; but the most elaborate refutation of Hobbes's materialism was made by the Cambridge Platonists Henry

More and Ralph Cudworth. Mind, they said, is an absolute and independent spirit. God, the highest example of spirit, gave to the world a plastic nature of its own to perform the menial tasks of God's creation. Spirit is immaterial, penetrable, and circumscribed. Only the spirit of God is boundless, and to Henry More, whose imagination was stirred by astronomical discoveries, infinite space was analogous to, perhaps identical with, the divine being itself.

In support of these theories the Cambridge Platonists invoked the traditional ontological and teleological arguments; in addition, More argued from natural science, claiming that Boyle's experiments on vacuum proved the inefficacy of mere matter. More's ally Joseph Glanvill argued from the "evidence" of witchcraft. He believed that if we accept Hobbes's denial of witchcraft, we must accept his denial of all spirit, and hence of God.

Bishop Bramhall tried to expose the ethical "inconveniences" of Hobbes's determinism: it made God merciless for punishing the wicked, and it obliterated the distinctions between good and evil. Cudworth looked more deeply into the problem. In almost a thousand folio pages of manuscript, he tried to reconcile the doctrine of reward and punishment with a view of human nature actively inclined toward the good. In the end he failed; but he and the other critics would never accept Hobbes's ethics and moral psychology. Good and evil, they insisted, are absolute entities; natural law is eternal and immutable moral law, and not, as Hobbes maintained, a rational method for attaining civil peace. Moreover the critics believed that mankind is essentially decent. Against Hobbes's egoistic psychology such writers as Eachard, Clarendon, and especially Bishop Cumberland set the picture of a selfless, benevolent human nature.

Reading Hobbes's critics makes us aware of Hobbes's isolation in the seventeenth century. He left no disciples; he founded no school. Even the Restoration dramatists and wits such as Rochester were not true Hobbesists; they adopted certain loosely-distorted views of Hobbes for their own non-Hobbesian purposes.

Hobbes did however exert a subtle influence on his critics. He imposed on them his own strict standards of logical argument, causing them to lay aside their theological predilections and meet him on his own ground. When to this little-known development in the history of rationalism we add the spectacle of deeply-religious men resisting an essentially irreligious temperament, we find that the Hobbes controversy is an episode of unusual dramatic interest in the history of ideas.

Microfilm \$4.05; Xerox \$13.60. 313 pages.

A CRITICAL EDITION OF THOMAS HEYWOOD'S  
A CHALLENGE FOR BEAUTIE,  
WITH INTRODUCTION AND NOTES:  
EDITED BY WOODROW W. POWELL

(L. C. Card No. Mic 58-2832)

Woodrow W. Powell, Ph.D.  
Duke University, 1958

Supervisor: Charles E. Ward

This dissertation is a critical edition of Thomas Heywood's *A Challenge for Beautie*. The study includes an

Introduction, an Annotated Text, Explanatory Notes, and a Glossary. A new edition of the play has been greatly needed. Since the original publication in quarto in 1936, *A Challenge* has heretofore been edited only twice: by J. W. Dilke in *Old English Plays*, 1815, and by John Pearson in *The Dramatic Works of Thomas Heywood*, 1874.

In the Introduction I have presented the argument put forth by Freda Townsend for an early date and that of Frederick G. Fleay for a late date for the composition of *A Challenge*. I have suggested, however, that a date around 1625 seems more acceptable than either of the dates previously proposed.

It has been generally held that for both plots of the play no source is known. I have shown close parallels between the main plot of *A Challenge* and three other plays: Lope de Rueda's *Eufemia*, printed in 1567; Shakespeare's *Cymbeline*; and Philip Massinger's *The Picture*. It seems to me that in the last scene of *A Challenge* Heywood was following the final scene in *Eufemia* almost verbatim. The basic story of the subplot of *A Challenge* can be found in the popular ballad "Two Faithful Friends." Probably the dramatic details had already been filled in for Heywood in *Alexander and Lodowick*, a "new interlude" recorded in *Henslowe's Diary* in 1597, but now lost.

From a study of the critical opinion of both Heywood in general and *A Challenge* in particular, we can conclude that *A Challenge* is a significant play. In it Heywood shows himself not as the journeyman playwright of the early romances such as *Edward IV* and *The Four Prentises of London*, but as a practiced dramatist, exploiting the taste of the audience to bring about his own artistic aim: to present "some Mirth, some Matter, and perhaps some Wit."

The action of both the main plot and the subplot of *A Challenge* is centered in a contest. In the main action Queen Isabella of Spain vies with an English maiden, Helena, in beauty and virtue. In the secondary action the Spanish Valladura contests with the English Ferrers in magnanimity. A secondary theme in the play is male Friendship, which Heywood had used in *The Fair Maid of the West*, *The Fair Mayde of the Exchange*, and *The English Traveller*.

In the Introduction I have also presented a bibliographical analysis of the quarto. For this study I collated thirty-nine copies of the 1636 edition, the substantive text. Through close examination of the paper, running-titles, measurement of the compositor's stick, spelling habits, and press variants, I have been able to describe in detail the printing of the quarto. I have shown that in the printing of the nine sheets the presswork was interrupted eight times to make fifty-one changes. While many of these corrections involve mere punctuation, a catchword, or a signature, some are of such literary significance as strongly to suggest that the changes are authorial.

For the text of the play I have used a facsimile reproduction of both corrected and uncorrected states of the 1636 quarto. In textual annotations I have cited all textual variants and other differences between copies. I have also noted the major peculiarities in the printing.

In the Explanatory Notes I have tried to render the meaning of Heywood clear and complete. I have also shown that in *dramatis personae*, incidents, ideas, and phraseology Heywood was very much given to repeating himself.

Microfilm \$4.45; Xerox \$14.80. 345 pages.

## LANGUAGE AND LITERATURE, LINGUISTICS

### AN ETYMOLOGICAL AND PARTIAL SYNTACTICAL ANALYSIS OF THE *RIMADO DE PALAÇIO* OF PERO LÓPEZ DE AYALA

(L. C. Card No. Mic 58-2784)

Ann Opalak Bachmann, Ph.D.  
The Florida State University, 1958

The primary purpose of Part I is to provide for the use of the advanced student in Spanish, especially for the linguistics student, a complete etymological vocabulary of the *Rimado de palacio*, a versified satire written by Spain's leading statesman and literary figure of the second half of the fourteenth century. Since complete etymological and lexical studies of Old Spanish works are scarce, a dictionary for the *Rimado* should constitute a worthwhile contribution to documented knowledge of the language of Medieval Spain.

Part I is based on Marion A. Zeitlin's doctoral dissertation: "A Vocabulary to the *Rimado de palacio* of Pero López de Ayala." The etyma added to this lexicon are drawn, for the most part, from the recently published *Diccionario crítico etimológico de la lengua castellana* of J. Corominas. If taken from another dictionary or other source, the name is given, in abbreviated form, in parenthesis, following the etymology. If another source conflicts with Corominas' etymology of a given word, it is listed in addition, and the authority named.

Part II is entitled "The Use of *Ser* and *Estar* with Predicate Adjectives in Manuscript N of the *Rimado de palacio*," as found in Vol. I of A. F. Kuersteiner's *Posías del Canciller Pero López de Ayala*. The reason for selecting this manuscript is given in the Introduction. This study was undertaken in an effort to determine the extent to which the Old Spanish of the fourteenth century deviates from or corresponds to modern usage in the case of *ser* and *estar* with predicate adjectives. At the same time, it provides a compendium of rules for modern usage valuable to the beginning student and teacher of Spanish.

The first chapter of this division presents the over-all uses of *ser* and *estar* in Old Spanish. The second is a compilation of what has been written on the modern usage of *ser* and *estar* with predicate adjectives, including an exhaustive set of new rules for their correct employment. The third is a detailed analysis of *ser* and *estar* with predicate adjectives in manuscript N of the *Rimado*. The chief problem was to determine when a past participle was used to form the passive and when it had adjectival force, for only the latter type could be counted.

*Ser* and *estar* with adjectives and past participles used adjectivally are analyzed in four separate categories. Two more are devoted to *ser* and *estar* used with adjectives in impersonal expressions, and two to adjectives and adjectival past participles used with both *ser* and *estar*.

*Ser* predominated in all categories. No cases of *estar* in impersonal expressions were found. *Ser* has since lost its ability to express location, manner and physical states, and with past participles, to express a state resulting from action. In modern usage *estar* has gained where *ser* lost, especially in the domain of expressing state and personal emotion or subjective interpretation.

Microfilm \$8.00; Xerox \$27.80. 631 pages.

## THE SPEECH OF LOUISVILLE, KENTUCKY

(L. C. Card No. Mic 58-2918)

Robert Ray Howren, Jr., Ph.D.  
Indiana University, 1958

The chief foreign sources of the population of Louisville have been Germany and Ireland, especially the former; the principal sources of native white American population of the city have been the South Atlantic and Middle Atlantic States (before the middle of the nineteenth century) and the North Central States (since the mid-nineteenth century). The Negro population, on the other hand, has been drawn largely from the South Central States. This study undertakes, through the analysis of some thirty-five hours of tape-recorded conversation with fifteen carefully selected native white and Negro residents of various ages and widely differing backgrounds, to describe the lexicon and phonology of the dialect which has emerged from this mingling of linguistic streams, and to comment somewhat less extensively on salient features of the morphology and syntax.

The vocabulary of Louisville speech is chiefly North Midland in character, and would seem to differ significantly from that of other Kentucky dialects in this respect. The vocabulary has, nevertheless, a strong South Midland flavor. We may say that the lexicon of Louisville speech is composed, roughly, of one part Southern words, three parts Northern words, and five parts Midland words. Considerable levelling of dialectal features may be observed, however, as a result of urbanization.

The prosodic features of the dialect are described in terms of three degrees of stress, four junctures, and four pitch-levels. Certain aspects of suprasegmental phenomena are treated in some detail: (1) the allophones of major stress and the lexical distribution of stress-patterns; (2) the allophones and distribution of microjuncture; (3) the allophones and distribution of the macrojunctures; and (4) the intonation contours and their variants.

The major portion of the study is devoted to a detailed description of the segmental phonology, which is, for white informants, characteristic of the South Midland area, and, for the Negro informants, basically Southern rather than South Midland. An examination of some regional patterns in the lexical distribution of phonemes reveals an overwhelming predominance of patterns typical of the Midland area in general, with a slight admixture of Southern features.

The study concludes with an examination of some miscellaneous features of the morphology and syntax which might prove significant for differentiating the speech of Louisville from that of other areas. Chief among the morphological items studied are the tense-forms of fifty-seven strong verbs, which show a heavy influence from the combined Midland-Southern area, with very little influence from the Southern area alone. The social distribution of these tense-forms is also studied, and, as in the vocabulary, the levelling effect of urban life is seen in the relatively large proportion of standard forms in general usage. On the whole, the Midland and Southern dialects combined are found to be not only the greatest contributors to Louisville tense-forms, but by far the most important influence on the morphology and syntax in general.

Microfilm \$2.75; Xerox \$9.60. 211 pages.

A STUDY OF THE INFLUENCE OF ENGLISH  
ON THE SPANISH OF PUERTO RICANS  
IN JERSEY CITY, NEW JERSEY

(L. C. Card No. Mic 58-3691)

Charles William Kreidler, Ph.D.  
University of Michigan, 1958

The purpose of this study is to discover the amount and nature of change in the Spanish dialect of a group of Puerto Ricans as a result of their exposure to English in the mainland community in which they have settled. The importance of this study in the much neglected field of inter-language influences derives, aside from the recentness of the particular contact situation under investigation, from the attention given to the structural implications of language borrowing. The theoretical considerations involved draw largely from the recent works of Haugen, Weinreich and others, whose writings are summarized.

The linguistic material studied consists of 228 forms of English origin elicited from thirty informants in response to a prepared questionnaire. Informants were chosen to give adequate representation of groupings according to age, length of residence in the continental United States and comparative degree of exposure to English through employment, social contacts and cultural media.

A sketch is given of the socio-cultural background of the language contact situation. Jersey City, a community in the heart of the world's largest urban agglomeration, is characterized by a high degree of industrialization, ethnic heterogeneity and population saturation. The Puerto Ricans who settle there bring with them the results of American cultural influence in political and economic spheres already received in their island home, but retain Hispanic mores in family and social life. The consequent group solidarity largely hinders acquisition of fluency in English through social contacts outside the migrant colony. For the adult, employment is the prime locus of exposure to English.

A phonemic analysis of Puerto Rican Spanish shows five vowels, eighteen consonants and two degrees of stress. Vowels occur initially, medially and finally in isolable forms, alone and in clusters. Consonants are comparatively restricted in final occurrence and in the possibility of occurrence in clusters. In contrast, the Metropolitan New York dialect of English possesses twenty-one vowel and diphthong units, twenty-four consonants and four degrees of stress. The borrowing of English forms occasions innovations of two sorts in the phonemic structure of the Spanish dialect under study: certain consonants occur in new environments and a new consonant, /š/, is added to the inventory of phonemes.

Morphemic analysis of Puerto Rican Spanish reveals ten form classes. Borrowings from English are assigned to five of these classes in the following proportions: nouns 81%, verbs 7%, adjectives 6%, interjections 4% and adverbs 2%. Forms borrowed as nouns receive the usual Spanish inflection for number and are assigned to a gender category. In general, the assignment of gender correlates with the natural sex of the referent; when the referent is inanimate, the noun is most commonly assigned to the masculine gender. Forms borrowed as verbs are mostly assigned to the largest inflectional category of Spanish regular verbs. Forms borrowed as adjectives do not show the inflections for gender and number characteristic of this Spanish form class.

The findings of this study give some support to three general conclusions: 1) in a situation of language contact, borrowed forms in use by the more nearly monolingual members of the borrowing group show greater adaptation to the phonemic structure of the receiving language than do forms in use only by the more nearly bilingual members of the group; 2) in the adapting of foreign linguistic forms to the structural norms of the receiving language, there is greater likelihood of the occurrence of a native phoneme in a new position than of the borrowing of a new phoneme; 3) when a phoneme is borrowed into a language, its introduction may have been facilitated by the existence of a corresponding "hole in the phonemic pattern" of the receiving language.

Microfilm \$2.50; Xerox \$8.60. 190 pages.

### A DESCRIPTIVE ANALYSIS OF A DIALECT OF TAMIL

(L. C. Card No. Mic 58-2940)

Vadasery Iyemperumal Subramoniam, Ph.D.  
Indiana University, 1958

Supervisor: Fred W. Householder, Jr.

This study, which is the first modern descriptive analysis entirely based on a spoken dialect of Tamil (a member of the Dravidian family of languages spoken chiefly in South India), has two parts, Phonology and Morphology, divided into seven chapters. The informant is the author himself.

In the introduction, previous studies in the field, the nature of the corpus and the objectives of this study are discussed.

Contraction of words (characteristic of spoken Tamil) which presents some difficulty to the linguist, is handled here by dividing the discourse on the basis of the terminal boundaries into single word, phrase-word and phrase stretches. For the sake of objectivity spectrographic data have been extensively used to identify phones. Twenty-one successive (i.e., segmental) phonemes and five simultaneous (suprasegmental) phonemes are identified. They are i e a o u . p t k s m n ŋ r l ʃ v y ' ? , . . . Formants of vowels are charted. In stops the voiced-voiceless contrast is interpreted as short vs. long. Another new feature of this study is the analysis of successive phonemes into seven groups on the basis of acoustic distinctive features. Patterns of syllables and consonant clusters are listed. Cases of phonemic split and merger are also pointed out.

Internal sandhi rules are collected under Morphophonology.

On the basis of occurrence with affixes, stems have been divided into three classes--Verbs, Nouns and Particles.

The constituents (other than stems) of verbs and nouns are divided into three groups on the basis of their occurrence with one or more stem classes: Verb suffixes, Noun suffixes and Verb-Noun suffixes. The order of presentation in Morphology is, first, single word constituents and second, phrase-word constituents. Distribution of suffixes is given in four tables.

The partial contrast between past tense markers -nt- and -t- is neutralized by the use of a morphophoneme q.

On the basis of occurrence with the principal allomorphs

of the past tense morpheme, verb stems are classified into three sets. Each in turn is subdivided into subsets on the basis of the stem finals. Irregular stems are also listed. Conditions of stem alternation are given.

Noun stems are divided into simple and complex. On the basis of suffix set 210 both simple and complex stems are divided into five groups. A selective list of stems is given with their conditions of alternation.

The particles occurring in this dialect are listed. They are mostly phrase breaks and address words.

Appendix I has two sample texts, one in the author's dialect and another in a closely related prestige dialect. They are presented with partial interlinear numbering, word by word translation and free translation.

Microfilm \$2.00; Xerox \$6.20. 128 pages.

### JIVARO: PHONOLOGY AND MORPHOLOGY

(L. C. Card No. Mic 58-2942)

Glen D. Turner, Ph.D.  
Indiana University, 1958

The Jivaro Phonology and Morphology is divided into four parts: Part I treats the phonemics, Part II treats the morphophonemics, Part III treats the verb morphology, and Part IV treats the non-verb morphology. An appendix adds a general bibliography and short lexicon.

The phonemic inventory included p, t, k, c, č, s, š, h, m, n, ŋ, r, w, y, i, ɪ, a, u. The principal allophones are palatalized stops, nasals, h, and w. The bilabial stop and nasal and h have a labialized allophone. Stops demonstrate palatalized and non-palatalized varieties of voiced stops. w demonstrates palatalized and non-palatalized varieties of the labial fricative. Among vowels, /a/ is the least stable, varying from [e] to [o] to [a]. /i/ and /u/ have slightly lower allophones. Vowel additive components are tone and stress (possibly as a tone-stress system), nasalization, voicelessness, length (analysed as a sequence of like vowels). A brief treatment of juncture, intonation and certain non-systemic phenomena completes section 1. Section 2 treats phoneme classes as defined by distribution of the allophones. Section 3 gives relative frequency of recurrence of phonemes in short utterances. Section 4 treats loan words from Spanish and Quichua. Section 5 covers the distribution of phonemes. Two-consonant and two-vowel clusters are common word medial and are practically unlimited in internal arrangement. Three-consonant and three-vowel clusters also occur but are comparatively rare. Few inter-phonemic limitations in distribution are evident.

Part II is divided into three sections; 6 treats the automatic morphophonemic rules, 7 presents the morphophonemic shape of all the affixes. The allomorphs formulated by the morphophonemes are then distributed in section 8. Metathesis is common. Numerous allomorphs and apparently unpatterned interdependencies between allomorphs complicate the morphophonemics.

Section 9 begins Part III, introducing the morphology and giving the sub-classes of verb stems. Word order is extremely free, morpheme order is rigid. Stems divide primarily between verbs and non-verbs; non-verbs divide further into nouns and particles on the basis of privilege

of occurrence with the possessed suffixes. The affixes (all suffixes) are almost exclusively divided between verb suffixes and non-verb suffixes, with a very small number of suffixes which may occur with both stem classes.

Verb stems are divided into transitive and intransitive on the basis of privilege of occurrence with the transitive suffixes. All sequences including a verb stem are divided into five classes described in section 10. Class I includes the obligatory tense and person (actor-goal) suffixes, and the optional plural, negative and interrogative suffixes. Class II includes the obligatory imperative suffixes and optional plural and negative. Class III includes the obligatory subordinating suffixes and optional plural, negative, and conjunctive. Class IV includes the obligatory deverbalizing suffixes and optional negative. All the above Classes are determined by obligatory and optional suffix relationships to the verb stem. Class V is determined by association of two deverbalizing suffixes with a restricted sequence of Class I.

The principal feature of the arrangement of verb suffixes is the interdependencies between the transitive suffixes and actor-goal suffixes. Transitive suffixes are aligned with the stem in such a manner as to form three transitive stems. Each transitive stem with its interdependencies with the actor-goal morphemes accounts for a specific portion of the total actor-goal paradigm. Inasmuch as the actor-goal semantic component occurs correlated with discrete morphemes in Class I verb sequences and with the imperative morphemes in Class II sequences and with most of the subordinating suffixes in Class III sequences, the transitive relationships are pervasive throughout a large portion of the verb structure.

All non-verb suffixes may occur in sequence with noun stems. One sub-class of particles may occur with all but the possessed suffixes. When the possessed suffixes occur, the remaining suffixes have a unique order. When the possessed suffixes do not occur a different order is established which remains the same whether following a noun stem or a particle stem.

Microfilm \$2.10; Xerox \$7.40. 157 pages.

## LANGUAGE AND LITERATURE, MODERN

### THE FIGURE OF THE CATHOLIC PRIEST IN THE WORKS OF FRANZ WERFEL

(L. C. Card No. Mic 58-2955)

Prudent Camiel Coussens, Ph.D.  
State University of Iowa, 1958

Chairman: Associate Professor Fred L. Fehling

Franz Werfel is best known to the general public as a Jewish apologist for the Catholic faith, although he could never bring himself actually to join the Church. In his spiritual development he comes, by his own admission, from materialistic origins. His early work is lyric, filled with exuberance and warmth, and the sheer joy of existence. Heavily influenced by Dostoevski and disillusioned by World War I, he becomes concerned with the problems of guilt

and redemption, is early convinced of the truth of Christianity. He moves to the wider audience and the more pointed delivery of the drama, consumed by the growing conviction of a spiritual mission. As his life progresses, particularly on the "via dolorosa" of his own exile he comes ever closer to the Catholic Church, though death still finds him "extra muros" in manifold ways.

Because his themes are so often Catholic, the Catholic priest is a frequent character in his books. The works of the twenties show a marked anti-clericalism, a disposition common in expressionists. Around 1930 one begins to notice a new warmth in his treatment of the clergy. This becomes very pronounced in the works just preceding and during exile. Even to the very end, however, there are vestiges of distrust of the established forms of the visible church.

In Werfel's works clerics of almost every rank are depicted, upwards of forty different characters. One cannot honestly say that he prefers one rank to another; there are good and bad, indiscriminately placed. His treatment of the popes is characterized by particular reverence. In some books his priests play major roles, in others relatively minor ones. In only one book, *Der veruntreute Himmel* (Embezzled Heaven), is the priesthood something of a central theme, specifically the power of sacrifice.

Werfel generally does not occupy himself with the development of the priestly character, nor with the essence of the priestly powers. He treats the priest more from his human side. His analysis of the spiritual life contains the normal elements of the mastery of the ego and the positive acquisition of divine love, but the latter stage he does not understand well.

The dissertation is written from a Catholic point of view, frequent observations are made on Werfel's lack of dogmatic accuracy. In strictly theological periodicals, Catholic criticism is rather severe. Although he has won relatively wide popular acceptance among Catholics, his books contain a great deal of heresy and questionable philosophy. He is accused by competent authorities of Hegelianism and Modernism, his religion is purely emotional, his God a creation from within. In a number of instances his priests are made vehicles of these errors. A detailed analysis of his priestly characters is made with ample reference to both primary and secondary sources. There are pertinent data about his personal life and acquaintance with Catholic clergy, but no attempt is made to determine the prototypes of the priests in the various books. Essentially the treatment is chronological.

The Catholic priest is a difficult character to treat properly and effectively in a novel. This lies rooted in his very nature. There is question whether a satisfactory treatment of the subject is possible at all in this medium. In spite of the criticisms offered, it may be said that Franz Werfel's contribution has been significant and not without some success. Microfilm \$2.85; Xerox \$9.80. 219 pages.

A GLOSSARY OF "FILIPINISMOS" IN THE  
SPANISH LANGUAGE FOUND IN PHILIPPINE  
PUBLICATIONS OF THE PERIOD 1890-1920

(L. C. Card No. Mic 58-3654)

Edith Aultman Doty, Ph.D.  
University of Michigan, 1958

The purpose of this study is the collection and verification of those words, foreign to standard Spanish, which were commonly used in the Spanish of the Philippines between the years 1890 and 1920. Among them will be found words from native tongues and other languages which have entered Philippine Spanish. In addition there are peninsular Spanish words which acquired special meanings through adaptation and use during the Spanish era and thus may correctly be classed as *filipinismos*. Quite a few of these words and meanings have become an integral part of Standard Spanish and are now included in the Academy Dictionary.

As a basis and point of departure, four principal lexicographical works were carefully consulted:

1. Blumentritt, Ferdinand. Vocabulaire de locutions et mots particuliers a l'Espagnol des Philippines. Traduit par A. Hugot. (Extrait n° 12 du Bulletin de la Société Académique Indo-Chinoise), 2<sup>e</sup> série, t. II, Mai 1882.
2. Retana, Wenceslao E. Diccionario de filipinismos con la revisión de lo que al respecto lleva publicado la Real Academia Española. Revue Hispanique, 1921. v. II, 7.
3. and 4. Real Academia Española. Diccionario de la lengua española. Madrid. 12<sup>a</sup> edición, 1884. 15<sup>a</sup> edición, 1925.

A list of *filipinismos* was compiled from the words and definitions found in these works. When the various works differed regarding the meaning of a word, all the variations have been tabulated, but when the definitions coincided only one definition has been given. A few additional words were added which did not appear in any of these basic works but which were discovered in extensive reading or in interviews with an informant. However, these words have been included only when it was possible to verify them with at least one other source or an additional informant.

After the *filipinismos* had been collected, wide readings of Philippine publications of the years 1890 to 1920 yielded examples of usage which serve to verify a greater part of the terms listed. There were a number of terms for which it was impossible to find citations, while the better known words appeared repeatedly. At times the informants were the only source of verification. While native etymologies have been included when offered by some authority, no effort has been made to study or to verify them.

Due to the time element and geographic distance from the locale being studied, it has been difficult if not almost impossible to locate informants for the period under consideration. The available informants represent two socio-economic classes: (1) Spanish and urban, and (2) mestizo and rural. As a consequence there is a notable difference in the *Filipinisms* familiar to them. Presentday Filipinos are of limited value in this particular study.

The reading done for this study has revealed the need for a far more extensive glossary of *Filipinisms*. Today

there appears to be a definite effort on the part of the Philippine government to develop the use and study of Spanish in the Islands which will undoubtedly bring a renewed interest in Philippine Spanish literature. Unless glossaries are made of terms already obsolete, generations to come will sometimes have difficulty in understanding what is meant by the writers of Philippine Spanish works of the past centuries. This was clearly demonstrated when our young Filipino informant had no knowledge of several terms which were still in current use during the period covered.

This glossary can in no way be considered a complete list but merely the basis for a further study which can only be satisfactorily accomplished by field work in the Philippine Islands themselves.

Microfilm \$4.65; Xerox \$15.60. 361 pages.

FRENCH INTERPRETATIONS OF THE LIFE OF  
JESUS (1933-1953): A CRITICAL ANALYSIS

(L. C. Card No. Mic 58-2913)

Lois Mary Gunden, Ph.D.  
Indiana University, 1958

As the result of research prior to 1920, many scholars of that period felt that it was no longer possible to write about the life of Jesus. But since 1930 an increasing number of interpretations of that life have appeared. And the authors of these works have been philosophers and men of letters as well as theologians and historians. Through critically analyzing seven works selected from these interpretations, this study attempts to determine the effect that previous research has had upon them and to discover whether any significant trends in the approach to the problem can be noted. In other words, it seeks to indicate what the contemporary writers may be contributing to the solution of the problem.

The general procedure for carrying on this study was suggested by Albert Schweitzer's *Von Reimarus zu Wrede*, which analyzes and evaluates works selected by him as significant attempts to depict the historical Jesus. In this case, seven recent interpretations of Jesus' life were chosen to represent various approaches to the problem now being made by different groups of writers. The three historians selected, Father Ferdinand Prat, Charles Guignebert, and Maurice Goguel, represent the approach of both Catholic and Protestant theologians as well as that of a pure historian. Daniel-Rops and Francois Mauriac represent the men of letters, and Paul-Louis Couchoud and Jean Guitton the philosopher-critics. The study analyzes such aspects of each author's approach as the following: criticism of the sources, method of presentation, treatment of crucial problems, portrayal of Jesus, and conclusions about Jesus' life and mission. A critique of each author, together with a summary of the authors in each category, indicates the major findings of each part of the study.

Several major findings result from this study. In the first place, each writer who treats a subject as controversial as that of Jesus has in mind a specific purpose and follows his own interest. Owing to this, his interpretation will bear his personal mark. Then, too, the measure of

independence exercised by a writer as he examines the problem is an important factor in determining both the method he follows and the conclusions he reaches. Furthermore, the scholar who recognizes the dual nature of the problem will seek to develop special techniques for understanding the religious as well as the historical aspect of Jesus' life. It also becomes clear that although previous research greatly influences the approach of the scholarly works, there are still those who by reason of personal belief in the reality of Jesus disregard the arguments of the critics.

This leads to several conclusions about the present status of attempts to deal with the problem of Jesus. As a result of critical studies of the documents, present interpretations tend to examine a few major problems in understanding the person of Jesus rather than sketching the story of His life. In thus providing the elements of a more convincing approach to the solution of the problem, contemporary writers may at least be clarifying, if not solving, the problem. Since the subject is highly controversial, its treatment will always reflect the personal viewpoint of the writer, and the resulting interpretations will therefore continue to be contradictory. In short, it appears impossible to answer the problem in a manner that will be convincing to all points of view.

Microfilm \$2.40; Xerox \$8.40. 184 pages.

#### THE NOVELS OF LEONARD MERRICK

(L. C. Card No. Mic 58-3676)

Warne Conwell Holcombe, Ph.D.  
University of Michigan, 1958

English novelists of the 1890's faced three problems peculiar to their period, or at least especially difficult then. The novelist's ever-present problem of creating a coherent "world" that would be accepted by readers as a microcosm yet have fresh appeal was particularly troublesome in this time of transition. This was so largely because of the disintegration of what David Daiches calls the "public truth" under the weight of advancing scientific materialism and of changing intellectual attitudes in general. An allied specific problem was the necessity of coming to terms with literary naturalism, which was the dominant literary force of the time. And finally, the perennial endeavor to improve the novel form was especially challenging then, partly as a side-effect of the other problems, which led to increased concern for realism and psychological probing in order to make the writer's world (or "private truth") credible.

Leonard Merrick's novels represent successful and largely original solutions to these problems. As his microcosm, Merrick takes the world of artists--actors, playwrights, novelists, musicians, and painters. His special province is the part of this world that we call Bohemia. Though earlier writers had treated this subject, none had treated it in the same way, their depictions being either romantic, implausible, and sentimental like Henri Murger's *Scènes de la Vie de Bohème* or naturalistic (and, hence, also distorted) like Moor's *A Mummer's Wife*. Merrick pictures this world realistically, with a naturalist's objectivity but without his preoccupation with sordidness. The dominant theme is the artist's struggle for success, or at times simply for a livelihood.

But this struggle often takes another form, becoming the artist's inward conflict as he must choose between worldly success and artistic integrity. The struggle becomes an ethical matter, as is the case in *The Actor-Manager*, Merrick's finest novel. In other works the conflict sometimes concerns a purely ethical problem without artistic implications. Merrick's realistic delineation of his characters' torment as they face these ethical dilemmas creates a "moral tension" which is the main differentiation of his realism from literary naturalism. It marks his rejection of the naturalists' deterministic philosophy, since his characters exercise free will in making their ethical choice. Though realism of this sort became the standard English answer to the importuning influence of naturalism, it was not at all clear by 1900 that this would happen, and Merrick thus represents those who shaped the tradition.

What Howells called "the singular shapeliness" of Merrick's novels results largely from the concern for theme rather than plot. At the heart of virtually every novel is an ethical dilemma, determining the structure and the characterization. Experiments to discover ways of heightening the moral tension led Merrick to adopt the scenic method (concurrently with Henry James) and later to return to a modified scenic technique. The dramatic quality of the novels also appears in other formal characteristics, approximating those of the "well-made" drama.

Microfilm \$2.00; Xerox \$7.00. 147 pages.

#### HUMAN VALUES IN THE POETRY OF ROBERT FROST: A STUDY OF A POET'S CONVICTIONS

(L. C. Card No. Mic 58-3242)

George Wilson Nitchie, Ph.D.  
Columbia University, 1958

This study is an examination of the human values expressed in Robert Frost's poetry. The six chapters deal with Frost's sense of man's relationship with Nature; his use of metaphor, especially as an expression of that relationship; his exploitation of unconscious motifs; his social values; his sense of man in relation to purposes either self-generated or implicit in the non-human universe; and the coherence of his values in comparison with those of certain major contemporaries.

Though deeply concerned with the "natural" world, Frost has no fully articulated theory of Nature. Man, Nature, and God are all-but-discontinuous orders of being; Nature's most persistent characteristic is its "otherness." Its principal function with respect to man is that of reducing his problems of choice to ultimate, impersonal simplicity, though it may occasionally provide cryptic intimations of divine purpose or design. More commonly, however, it acts simply as an impersonal force with which man may co-operate or against which he may assert his own designs and purposes.

Characteristically, Frost does not allow his metaphors, particularly those suggesting an organic relationship between man and Nature, to carry the full weight of his thought, preferring explicit statement to figurative devices, and often qualifying his metaphors by defensively ironic whimsy. Yet occasionally his images express highly

complex states of feeling, revealing an unconscious, "archetypal" dimension that contributes heavily to the effectiveness of the poem in which it appears.

Such archetypal matter constitutes a largely unconscious pattern analogous to that of the familiar Eden myth and enabling one to draw together seemingly disparate elements of Frost's work as a whole--such elements as the "innocent" mind or will, shared solitude, melancholy, anti-intellectualism, the exploitation of ambivalent states of feeling, and the problem of adjustment to a "fallen" condition. That pattern indicates Frost's capacity for a kind of power and for a psychological depth not often recognized by his critics nor implicit in the popular concept of Frost as a poet of native wisdom and canny common sense.

But Frost seldom exhibits any immediate awareness of collective aims or broadly social values, and often writes as though such aims and values were intrinsically undesirable. Frost's real social unit is the family in its minimal, husband-and-wife form; the only important social values are those relevant to that unit. This limited view of man's social nature inevitably narrows Frost's sense of human potentiality.

Frost's man can be defined as a choice-making creature; the indifferent universe confronts him with dilemmas, and he fulfills himself in the act of choosing, deliberately and with a sense of consequences. Yet this concept of man is compromised by an alternative concept that man fulfills himself by drifting with the stream of things. Ultimately, the problem is one of teleology, whether or not man fulfills any valid purpose in choosing. Even in the late masques, Frost evades this problem, and consequently his sense of man's essential nature remains obscured by an unresolved and persistently evaded ambiguity.

That ambiguity has hindered Frost from achieving an unambiguous greatness. Yeats and Eliot offer in their poems a body of developed convictions; they have chosen, as Frost has not, to accept theories of man and of the world he inhabits. One need not agree with those theories in order to recognize that they enable their authors to deal with man in a more broadly meaningful context than Frost permits himself. Frost has written a handful of great poems, but, lacking sustaining convictions, his work remains too incomplete to justify one in assigning it equal value with that of his major contemporaries.

Microfilm \$3.50; Xerox \$12.00. 272 pages.

#### THE TWO WORLDS OF JOSEPH CONRAD

(L. C. Card No. Mic 58-2929)

Walter P. Poznar, Ph.D.  
Indiana University, 1958

Throughout Conrad's novels and tales there are constant references to a basic conflict which man must face, a conflict that, in essence, never changes its character. In every society the individual inevitably comes to accept unequivocally the customs and laws which constitute the fundamental beliefs of his world. He rarely questions these beliefs, because they seem to promise him a life which will be carefully ordered and integrated, which will protect him from doubt and fear and anxiety, which will relieve him of the burden of thought. Everything which tends to condition him in the acceptance of this world is tangible, knowable. It may take the form of a reward that

society offers to the person who can achieve a particular kind of distinction, or it may appear as a conventional way of resolving a difficulty. The world of the surface is a world which exists everywhere, although the particular shape it assumes in one area of the world may not correspond to the shape it assumes in another. Always it presents itself as a system of laws, conventions, customs, traditional ideologies, accepted habits of behavior, moral values, and social strata.

In the world of the surface life is patterned. There are certain rules that every individual must follow, as there are certain beliefs that he must accept. He is offered in return security, order, a scale of values upon which he can build his life, a particular function to perform. These influences upon him are so pervasive, so much a part of the air he breathes, that they are rarely questioned or examined with any care. The person who lives his whole life within this world, the world of the surface, is leading a conditioned existence, one which has been slowly but irresistibly forced upon him. He may be a success in the eyes of his society, but so long as he fails to understand the extent of his dependence upon the world of the surface he remains nothing more than a creature of limited vision. He knows little about himself because his attention has always been centered on other interests, on the known, that which can be seen and touched and handled. He remains ignorant of life because he has never seen below the surface of his existence.

In contrast to the world of the surface, the world of the known, there is, in Conrad, the world of the unknown, those darker regions of the self and of the universe where the individual loses all sense of direction, in which he is helpless because he can no longer call upon his conditioned values to support and sustain him. It is this world of fear and uncertainty that Conrad depicts so often, for without a knowledge of this world man is powerless to cope with the basic questions that every intelligent person must at some time in his life face. Although the conditioned person feels secure, his life may at any moment be threatened by the sudden intrusion of some power, some force that defies classification, that paralyzes the will and unnerves the spirit.

No man can ever come to grips with himself and life unless he is willing to face the terrors of the dark, the unknown fears that test his courage and force him to stand on his own resources. This period of doubt and anxiety is analogous to Christian's journey to Heaven, although in Conrad we rarely if ever get the feeling that an individual has won through to salvation. Always there is an unresolved dissonance that somehow refuses to yield up its secret. Conrad inevitably ends a story not on a note of triumph, but on a note of awareness.

Microfilm \$2.85; Xerox \$9.80. 219 pages.

#### SELECTED REVIEWS OF WILLIAM EDMONDSTOUNE AYTOUN

(L. C. Card No. Mic 58-3083)

Robert C. Schweik, Ph.D.  
University of Notre Dame, 1958

It is the purpose of this dissertation to bring together the best of Aytoun's *Blackwood* reviews and to supply them with an introduction and notes. The introduction (164 pp.) contains a study of Aytoun's life during the crucial period

when he joined the Blackwood staff, a survey of his critical principles, an analysis of the rhetoric of his reviews, a chronologically arranged commentary on them, and a conclusion. The edition, ten reviews in all, is based on the Blackwood texts, and notes are provided to indicate emendations and to supply clarifications. The bibliography includes a list of all of Aytoun's unsigned contributions to Blackwood, including some poems not printed in the Page edition of Aytoun's poetry, as well as a list of the manuscript materials used in preparing the edition.

Aytoun began writing reviews for Blackwood less from choice than from a desire to use the Blackwoods' influence to obtain a professorship at the University of Edinburgh. However, he soon became convinced of the rightness of the Blackwoods' causes--particularly opposition to free trade--and shortly was devoting much of his time to writing political and economic articles as well as short tales and both serious and burlesque verse.

Paradoxically, Aytoun's talent for literary burlesque contributed to his weakness as a reviewer, for it made him more than usually conscious of the possibility of sham in literature. He had noted how close his own burlesques had come to genuine poetic expression, and he was not always certain of his ability to detect the difference. This, coupled with a body of critical principles which favored a literature of clear, commonsense expression and orderly arrangement, sometimes led him to unnecessary concern for the genuineness of an author's emotion or to overly strict demands for clarity and simplicity. By modern standards he too often wielded an axe where he should have used a scalpel.

But when he was careful--and he reviewed some of the major literary figures of his day with care--he often made judgments of considerable literary tact, and some of his insights and judgments still pass muster today; he was not, however, above permitting a political, religious, social, or personal bias to affect his literary judgment. But he managed to produce reviews which can almost always be trusted to entertain even when they cannot be always trusted to present an adequate judgment. The humor of his reviews is not merely in an amusing remark here or there; still less is it mean or vicious. Rather, it is the result of a fusion of matter and manner in which the humor supports the judgment of the review both in general and in particulars. In fact, Aytoun's rhetorical strategy in his reviews can be fairly described as the conscious manipulation of humor. Many of Aytoun's contemporaries more frequently produced sounder literary judgments, and many were better humorists. But few, if any, managed to combine the two functions quite as well as Aytoun did. It is this quality--the fusion of literary insight with original humor--which makes his reviews stimulating reading even today.

Microfilm \$6.85; Xerox \$24.00. 539 pages.

#### THE PARADOX OF GEORGE ORWELL

(L. C. Card No. Mic 58-2946)

Richard Joseph Voorhees, Ph.D.  
Indiana University, 1958

Major Professor: Robert G. Kelly

Three major paradoxes run through the life and work of George Orwell.

First, Orwell was a rebel with a remarkably strong sense of responsibility. When he was a child, he revolted against the religious teachings of his school and against the masters and the older boys. The mature equivalents of his boyhood feelings were his hostile attitudes toward organized religion and toward social, political, and cultural authority. As charitable organizations, Orwell thought, the churches were demoralizing; as moral and political forces, they were puritanic and reactionary; as a spiritual force, they were worthless. Orwell felt contempt for the aristocracy and resented every sort of governmental and social pressure. His rebellion extended even to literary criticism: he rejected the usual critical assumptions and denied that criticism was a force, good or bad, in culture. Because Orwell's rebellion was comprehensive and occasionally violent, some critics have considered him to be neurotic. Their theories, however, attribute to Orwell feelings which his life and writing contradict. Orwell's sense of responsibility was eminently sane and practical. He lived with the poor to find out exactly what poverty was like. Though deficient in religious feeling himself, he recognized what society loses when religious feeling deteriorates. And despite his rejection of all political orthodoxies, he was closely engaged, as his life and his writing demonstrate, in the political issues of his time.

Second, Orwell was horrified by large concentrations of power, but he never wavered in his resolution to resist them. In the first stage of his career he was preoccupied with the evils of imperialistic power, which he attacked mainly in Burmese Days. In the last stage of his career he was preoccupied with the evils of totalitarian power, which he attacked mainly in Animal Farm and Nineteen Eighty-four. The preoccupation with totalitarianism, however, was not a surrender. In Nineteen Eighty-Four Orwell is not predicting universal totalitarianism in our time. To begin with, he was always dubious about the value of political prediction. Besides, in Nineteen Eighty-Four he takes countless details from totalitarianism as it was at the time of the book, and he makes no attempt at plausible prediction.

Third, Orwell crusaded for a socialistic society, yet he had important reservations about socialism. The inequalities and inefficiencies of capitalism, together with the decay of the ruling classes proved to Orwell the urgent need for socialism. Socialists would have to contend, however, with the privilege and tradition of conservatives, with reciprocal antagonisms between classes, and even with certain types in their own ranks, such as eccentrics and petty despots. Orwell was confident that socialism could succeed; he was not pleased with some of the corollaries of socialism. He knew that socialism implied increased mechanization, but he had an aversion to twentieth-century machinery and to its products. Similarly, he knew that a socialistic government would have to invade areas of life which capitalism does not invade. He therefore felt a nostalgia for nineteenth-century England, where life was simpler and in some ways freer than it would be in the society toward which he worked.

Microfilm \$2.15; Xerox \$7.60. 163 pages.

THE BESSEL POLYNOMIALS  
AND SOME RELATED FUNCTIONS

(L. C. Card No. Mic 58-2724)

Waleed A. Al-Salam, Ph.D.  
Duke University, 1958

Supervisor: Leonard Carlitz

The generalized Bessel polynomials,  $Y_n^{(\alpha)}(x)$ , were introduced by Krall and Frink [A new class of orthogonal polynomials: the Bessel polynomials, Transactions of the American Mathematical Society, vol. 65 (1949), pp. 100-115] as the polynomial solution of the differential equation

$$(1) \quad x^2 y''(x) + (\alpha+2)x y'(x) = n(n+\alpha+2)y(x) \\ (n = 0, 1, 2, 3, \dots; \alpha \text{ arbitrary})$$

which satisfies the condition  $y(0) = 1$ . They proved among other results that they are orthogonal on the unit circle with respect to the weight function

$$(2) \quad \rho(x, \alpha) = \frac{\alpha+1}{2\pi i} {}_1F_1\left[1; \alpha+1; -\frac{2}{x}\right]$$

and that any three consecutive polynomials satisfy the recurrence relation

$$(3) \quad (n+\alpha+1)(2n+\alpha) Y_{n+1}^{(\alpha)}(x) \\ = (2n+\alpha+1) \left\{ (2n+\alpha)(2n+\alpha+2) \frac{x}{2} + \alpha \right\} Y_n^{(\alpha)}(x) \\ + n(2n+\alpha+2) Y_{n-1}^{(\alpha)}(x) \quad (n \geq 0) \\ Y_0^{(\alpha)}(x) = 1, \quad Y_1^{(\alpha)}(x) = (\alpha+2) \frac{x}{2} + 1.$$

This dissertation is divided into four parts. In part I, we extend the study of the generalized Bessel polynomials. We obtain integral representations, generating functions, and various other expansion formulas.

In part II we define a second independent solution of the differential equation (1),  $Z_n^{(\alpha)}(x)$ , which is an analytic function in the plane cut along the positive real axis. We furnish its analytic continuation and find that the jump on the cut has the value

$$-2i \sin(\alpha\pi) Y_n^{(\alpha)}(x).$$

It is also shown that  $\{Z_n^{(\alpha)}(x)\}$  satisfy the recurrence relation (3). Other recurrences, integral representations, expansion formulas as well as generating functions are given.

In the third part we introduce, as in the case of the classical orthogonal polynomials, a set of polynomials  $\{V_n^{(\alpha)}(x)\}$  which gives a second independent polynomial solution of (3), i.e., those which satisfy the initial conditions

$$V_0^{(\alpha)}(x) = 0, \quad V_1^{(\alpha)}(x) = 1.$$

We apply known theorems from the theory of continued fractions to prove the orthogonality of  $\{V_n^{(\alpha)}(x)\}$  on the unit circle with respect to the weight function

$$\Omega(x, \alpha) = \frac{1}{2\pi i} {}_1F_1\left[1, \alpha+2, -\frac{2}{x}\right].$$

The special case  $\alpha = 0$  is discussed. This leads to interesting identities involving the Bernoulli and other related numbers. For this case, it is shown how an orthogonality on the imaginary axis with respect to a discrete weight function can be obtained.

Finally we give in section IV various Christoffel-Darboux identities as well as several theorems on the location of the zeros of  $Y_n^{(\alpha)}(x)$ ,  $V_n^{(\alpha)}(x)$ , and  ${}_1F_1\left[1, \alpha+2, -\frac{2}{x}\right]$ . Microfilm \$2.00; Xerox \$3.00. 60 pages.

NECESSARY CONDITIONS FOR CONTINUATION  
AND REFLECTION PRINCIPLES FOR SOLUTIONS  
OF HOMOGENEOUS LINEAR PARTIAL DIFFERENTIAL  
EQUATIONS WITH CONSTANT COEFFICIENTS

(Publication No. 24,863)

Robert I. Canavan, S.J., Ph.D.  
New York University, 1957

Adviser: Fritz W. John

The general homogeneous linear partial differential equation of order  $N$  with constant coefficients for a function  $u(x, t) = u(x_1, \dots, x_n, t)$  can be written in the form

$$(1) \quad P(\xi, \tau) u(x, t) = \\ \sum_{k=0}^N P_{N-k}(\xi_1, \dots, \xi_n, \tau) u(x_1, \dots, x_n, t) = 0,$$

where  $P_{N-k}(\xi_1, \dots, \xi_n, \tau)$  is a homogeneous form of degree  $N-k$  in the variables  $\xi_1, \dots, \xi_n$  and  $\tau$  for  $k = 0, \dots, N$ ,  $\xi_i$  is the operator  $\partial/\partial x_i$  for  $i = 1, \dots, n$ , and  $\tau$  is the operator  $\partial/\partial t$ . The solutions of this equation which are treated in this dissertation are subject to the restrictions that

$$(2) \quad [\tau^k u(x_1, \dots, x_n, t)]_{t=0} = 0 \quad (k=0, \dots, s-1)$$

for some positive integer  $s \leq N$ . In addition it is assumed that the hyperplane  $t = 0$  is non-characteristic.

Equation (1) is said to possess a continuation principle with respect to the data prescribed in (2) provided that there is an  $N' \geq N$  such that every solution of (1) which satisfies the conditions prescribed in (2), which belongs to class  $C^{N'}$ , and which is defined on a closed set of the half-space  $t \geq 0$  abutting on the hyperplane  $t = 0$ , can be continued as a solution of equation (1) which is of class  $C^N$  into the half-space  $t < 0$ . Equation (1) is said to possess a reflection principle with respect to the data prescribed in (2) provided that there exists an  $\epsilon > 0$  which depends only on the operator  $P(\xi, t)$  and which is such that every solution of equation (1) which satisfies the conditions prescribed in (2) and is analytic in a cylindrical set

$$\{x \text{ in a domain } D \text{ of } x\text{-space}, 0 \leq t < h\}$$

can be continued as an analytic solution of (1) into the set

$$\{x \text{ in } D, -\epsilon h < t \leq 0\}.$$

For any vector  $\eta = (\eta_1, \dots, \eta_n)$ , with real or complex components, let  $\nu_+(\eta)$ ,  $\nu_0(\eta)$ ,  $\nu_-(\eta)$  denote the number of roots of the characteristic polynomial of equation (1),  $P_N(\eta_1, \dots, \eta_n, \lambda) = 0$ , which have positive, zero, negative imaginary part, respectively. Define the real rank,  $R_r$ , and the complex rank,  $R_c$ , of equation (1) as follows:

$$R_r = \begin{cases} \text{maximum}[\nu_+(\eta) + \nu_0(\eta)], & \text{if } \nu_+(\eta) \neq 0 \text{ for } \eta \text{ real,} \\ \eta \text{ real} \\ \nu_+(\eta) > 0 \\ 0 & , \text{ if } \nu_+(\eta) \equiv 0 \text{ for } \eta \text{ real,} \end{cases}$$

$$R_c = \begin{cases} \text{maximum}[\nu_+(\eta) + \nu_0(\eta)], & \text{if } \nu_+(\eta) \neq 0 \text{ for } \eta \text{ complex,} \\ \eta \text{ complex} \\ \nu_+(\eta) > 0 \\ 0 & , \text{ if } \nu_+(\eta) \equiv 0 \text{ for } \eta \text{ complex.} \end{cases}$$

The present results are an extension of those obtained by Fritz John for the case of equation (1) when only derivatives of order  $N$  occur in the equation. It is first proved that a necessary condition for equation (1) to possess a continuation principle with respect to the data prescribed in (2) is that  $R_r \leq s$ . Secondly, it is proved that a necessary condition for equation (1) to possess a reflection principle with respect to the data prescribed in (2) is that  $R_c \leq s$ .

Microfilm \$2.00; Xerox \$3.80. 67 pages. Mic 58-5077

# COMPARISON OF DESIGNS FOR EXPLORATION OF RESPONSE RELATIONSHIPS

(L. C. Card No. Mic 58-2996)

John Leroy Folks, Ph.D.  
Iowa State College, 1958

Supervisor: Oscar Kempthorne

Of paramount importance to statistical work, and indeed to a major portion of scientific endeavor is the detection and description of functional relationships between two or more variables. An empirical investigation of such relationships consists of observing the response at certain combinations of controlled variables. In recent years attention has been focused upon the choice of combinations of the controlled variables. It is difficult to specify conditions which will lead to an optimal choice of combinations of controlled variables because there are conflicting aims and needs. Any work is bound to be exploratory in nature. It appeared that an initial attack should concentrate on specific functional relationships with specified deviations from these relationships in mind and that these should be explored on the basis of various criteria of adequacy.

In this study only polynomial type relationships were considered and the choice of design, that is, of combinations of controlled variables to be used, was restricted to

an experimental region  $R$ . The estimated response at the point  $u$  in  $R$  was denoted by  $\hat{y}(u)$  and the variance of  $\hat{y}(u)$  by  $V(u)$ . In the event that the true response  $f(u)$  is not equal to the expectation of  $\hat{y}(u)$ ,  $\hat{y}(u)$  is biased. The bias was defined to be  $|E\hat{y}(u) - f(u)| = B(u)$ .

The comparison of designs must of necessity employ the use of specific criteria of goodness of design. Only criteria leading to invariance of relative efficiency of designs under simple linear changes of scale of the factor space were considered. They were as follows:

1. minimum maximum variance of  $\hat{y}(u)$
2. minimum average variance of  $\hat{y}(u)$
3. minimum generalized variance
4. minimum maximum bias of  $\hat{y}(u)$
5. minimum average bias of  $\hat{y}(u)$
6. minimum average (bias)<sup>2</sup> of  $\hat{y}(u)$
7. minimum average mean square error
8. maximum power of detecting higher order terms.

Optimal designs were obtained for most of these criteria for first degree polynomial relationships and for certain second degree polynomial relationships.

Microfilm \$2.00; Xerox \$5.20. 103 pages.

# VIBRATION OF HOLLOW ANISOTROPIC THICK-WALLED CYLINDERS

(L. C. Card No. Mic 58-3679)

Richard P. Jerrard, Ph.D.  
University of Michigan, 1958

The problem treated here is the vibration of a thick-walled cylinder whose cross section is an annulus. The material has the same type of anisotropy as a uniform length of tree trunk; that is, in the small it is orthotropic. The assumption is made that the state of strain is plane strain, and the vibration takes place in directions normal to the axis of the cylinder. This problem arises in the construction of large generators; the cylinder in question is an idealization of the stationary part of such a generator.

To solve this problem, the equations of equilibrium are obtained in a suitable form, taking into account the effect of anisotropy. The boundary conditions, which are that the lateral surfaces of the cylinder are free of load, are expressed in equation form. It is found that the partial differential equations of equilibrium can be separated and these equations then are reduced to a pair of ordinary, linear, differential equations in two unknowns. These unknowns are the displacement components.

The solution of this system of equations is carried out in three parts. First, the equations are solved for the special case when the material is isotropic rather than anisotropic. Second, a solution is obtained for anisotropic material in the special case when the displacement is axially symmetric. Finally, a general solution is obtained for anisotropic material without the restriction on the displacement. In the first two solutions, the results are obtained in finite form in terms of Bessel functions. The natural frequencies of vibration are obtained as roots of a certain transcendental equation which arises when the boundary conditions are applied. The third solution is by a perturbation method, based upon the solution for the isotropic case. The natural frequency is expressed as an infinite

series, the terms of which can be regarded as successive corrections to the first term, which is the frequency in the isotropic case.

The main results of this study are the equations given for computing stresses and natural frequencies in this type of vibration. There is also an analysis of different modes of vibration which have apparently not been discussed before. Some numerical results are given, including estimates of the lowest frequency in various different modes of vibration.

The method used in this study appears to be the easiest way of obtaining the desired results, though several other methods are possible. Of particular interest are the modes of vibration. It is possible that vibration in some of these modes may have caused failure of machinery, heretofore laid to other causes.

Microfilm \$2.00; Xerox \$4.80. 93 pages.

#### ELASTIC PROBLEM OF A LONG CIRCULAR CYLINDER WITH A SHRINK-FITTED COLLAR

(L. C. Card No. Mic 58-3006)

Roger Dean Low, Ph.D.  
Iowa State College, 1958

Supervisor: H. J. Weiss

A formal solution of the mixed boundary value problem of a long circular cylinder with a shrink-fitted collar has been obtained by the use of a Fourier sine transform. This approach led to a pair of dual integral equations whose solution supplied the stress function from which the components of stress and displacement were obtained. The solution of the dual integral equations led to an infinite system of linear equations and it was found that twenty of these equations were sufficient to give a good approximation to the solution of the system. This 20 x 20 system was solved on the I.B.M. 650 at Iowa State College.

As an application of the results, a numerical example was considered and an attempt was made to determine the stresses and displacements on the axis of the cylinder and the normal stress on its lateral surface. The outcome indicated that a more extensive numerical treatment would be required if one were interested in the precise nature of the stress and displacement distributions, especially on the boundary of the cylinder. The results on the axis, however, gave a good qualitative description of the behavior of the stresses and displacements.

Microfilm \$2.00; Xerox \$3.00. 37 pages.

#### ALMOST PERIODIC MOVEMENTS IN UNIFORM SPACES

(L. C. Card No. Mic 58-3009)

Gary Hosler Meisters, Ph.D.  
Iowa State College, 1958

Supervisor: Carl E. Langenhop

Hans Tornehave's theory of almost periodic movements in metric spaces [Dan. Mat. Fys. Medd. 28 no. 13 (1954)] is generalized to a theory of almost periodic movements in uniform spaces. After the appropriate definitions have been made most of the theorems can be proved as in Tornehave's work, with only minor changes necessary to adapt them to the more general structure of a uniform space. However, a weaker definition of completeness than is usually adopted for uniform spaces proves to be sufficient for this generalization. The definition adopted here is as follows: a uniform space is called complete if and only if every closed and totally bounded subset is compact. Although this condition does not imply that the uniform space is complete in the usual sense (namely, that every Cauchy net converges), it does imply that every Cauchy sequence converges. Only those parts of the generalization are presented which are necessary to establish the analogue of Tornehave's approximation theorem.

Tornehave proves the following theorem (Theorem 1 in the paper referred to above): to each uniformly continuous family of almost periodic movements  $f(t;v)$  (in a metric space) there corresponds a real-valued almost periodic function  $g(t)$  such that the set of common  $\epsilon$ -translation numbers of all the functions  $f(t;v)$  contains the set of  $\epsilon$ -translation numbers of  $g(t)$ . The author makes use of this result to obtain a theorem concerning almost periodic solutions of a vector differential equation of the form

$$dx/dt = F(x,t) \quad -\infty < t < +\infty \quad (1)$$

Here  $F(x,t)$  denotes a vector-valued function defined for all real  $t$  and all vectors  $x$  in some connected open subset  $D$  of Euclidean  $N$ -dimensional space, such that (a)  $F(x,t)$  is almost periodic in  $t$  for each  $x$  in  $D$ , and (b)  $\|F(x,t) - F(y,t)\| \leq K \|x - y\|$  for all real  $t$  and all  $x$  and  $y$  in  $D$ . The theorem proved can be stated as follows: Let  $\phi(t)$  be a vector solution of Differential Equation (1) for all real  $t$ , and let  $D$  contain the closure of the range of  $\phi(t)$ . Then a necessary and sufficient condition that  $\phi(t)$  be an almost periodic vector function is that  $\phi(n)$ ,  $n = 0, \pm 1, \pm 2, \dots$ , be an almost periodic vector sequence.

Microfilm \$2.00; Xerox \$4.60. 89 pages.

#### ON STATISTICS WHOSE DISTRIBUTIONS DEPEND UPON A PARAMETER

(L. C. Card No. Mic 58-2979)

Gerald Stanley Rogers, Ph.D.  
State University of Iowa, 1958

Co-chairmen: Professor Allen T. Craig  
Assoc. Professor Robert V. Hogg

It is the object of this paper to investigate some aspects of the problem of determining whether or not the

distributions of certain statistics depend upon a parameter for cases in which the underlying random variables and the parameter are real. (Except in 1. below, the distributions are of either the discrete or the continuous type.)

Part I of the paper deals with functions having a monotone decreasing likelihood ratio (MDLR).

**Definition:** Let  $x_1, x_2, \dots, x_n$  and  $m$  be real variables. Denote the vector  $(x_1, \dots, x_n)$  by  $X$  and the function  $p(x_1, \dots, x_n; m)$  by  $p(X; m)$ . Call  $X < X'$  if and only if  $x_j < x'_j$  for  $j = 1, 2, \dots, n$ . Then  $p(X; m) \geq 0$  is said to have an MDLR if for all  $X < X'$  and  $m < m'$ ,

$$p(X; m)p(X'; m') \geq p(X; m')p(X'; m).$$

The following theorems relating to this definition are proved.

1. If the continuous type random variable  $x$  has a probability density function (pdf)  $f(x; m)$  with an MDLR, then the joint pdf of any set of order statistics based on a random sample from this distribution has an MDLR.

2. If the random variable  $x$  has a range independent of  $m$  and the pdf  $f(x; m) = \exp[p(m)K(x) + S(x) + q(m)]$  and  $x_1, \dots, x_n$  is a random sample from this distribution, then a)  $f(x; m)$  has an MDLR if and only if  $p(m)$  and  $K(x)$  have the same monotonicity; b) the pdf of  $z = \sum_{j=1}^n K(x_j)$  has an

MDLR if and only if  $p(m)$  is monotone increasing.

3. If the random variable  $x$  has the pdf  $f(x; m) = M(x)Q(m)$ , over the range  $a < x < b(m)$ , where  $a$  is independent of  $m$ , then  $f(x; m)$  has an MDLR if and only if  $b(m)$  is monotone increasing.

4. If the random variable  $x$  has the pdf  $f(x; m)$  and the moment generating function  $M(t; m)$ , then, when  $f(x; m)$  has an MDLR in terms of  $x$  and  $m$ ,  $M(t; m)$  has an MDLR in terms of  $t$  and  $m$ .

In Part II, the basic assumption is that the underlying pdf depends upon a parameter and the following theorems are proved.

5. If the random variable  $x$  has a pdf  $f(x; m)$  which depends upon the parameter  $m$ , then the pdf of any set of order statistics based on a random sample from this distribution is never free of  $m$ .

6. If the random variables  $x_j$ ,  $j = 1, 2, \dots, n$ , have pdf's of the form  $\frac{1}{s} f_j(\frac{x_j - m}{s})$ , where  $m$  is a location parameter whose domain is a non-degenerate interval of the real axis and  $s$  is a scale parameter whose domain is a non-degenerate interval of the positive real axis, then a) the distribution of  $z = \sum_{j=1}^n c_j x_j$ , where the  $c_j$  are constants not all zero, is free of  $m$  if and only if  $\sum_{j=1}^n c_j = 0$ ; b) the distribu-

tion of  $z$  is never free of  $s$ , degenerate distributions excluded.

The appendix contains another theorem on order statistics.

7. If  $x_1 \leq x_2 \leq \dots \leq x_n$  are the order statistics based on a random sample of size  $n \geq 2$ , and  $z = z(x_1, \dots, x_j)$ ,  $j < n$ , then  $z$  is stochastically independent of  $x_j$  if and only if  $z$  is stochastically independent of  $x_k$ ,  $j < k \leq n$ . Combining

this result with a well-known theorem on sufficient statistics, one can then state: if  $x_n$  is a complete single sufficient statistic for the parameter  $m$  in a non-regular case of estimation where  $a < x < b(m)$ , then  $z = z(x_1, \dots, x_j)$ ,  $j < n$ , is stochastically independent of  $x_k$ ,  $j \leq k \leq n$ , if and only if the distribution of  $z$  is free of  $m$ .

Microfilm \$2.00; Xerox \$3.00. 33 pages.

# MINIMUM NORM SOLUTION OF A LINEAR EQUATION IN HILBERT SPACE IN TERMS OF SOLUTIONS OF RELATED PROJECTED EQUATIONS

(L. C. Card No. Mic 58-3015)

Ivan Dale Ruggles, Ph.D.  
Iowa State College, 1958

Supervisor: C. E. Langenhop

Let  $\{p_i\}$  and  $\{q_i\}$ ,  $i = 1, 2, \dots, n$  be two sets of linearly independent elements in a separable Hilbert space  $H$  and let  $T$  denote the operator defined on  $H$  as

$$Tf = \sum_{i=1}^n p_i(q_i, f), \quad f \in H.$$

Without loss of generality the set  $\{p_i\}$ ,  $i = 1, 2, \dots, n$  can be chosen orthogonal.

Let  $M_q$  and  $M_p$  denote the manifolds spanned by the sets  $\{q_i\}$  and  $\{p_i\}$  respectively.

For a given element  $g$  in  $H$  the equation  $Tf = g$  has a solution if and only if  $g \in M_p$ . For  $g \notin M_p$  there is a unique  $f' \in M_q$  such that

$$(1) \quad \|Tf' - g\| = \inf_{f \in H} \|Tf - g\|.$$

It is necessary and sufficient that this least norm solution  $f'$  satisfy

$$(2) \quad T^*Tf' = T^*g$$

where  $T^*f = \sum_{i=1}^n (f, p_i)q_i$ , that is,  $T^*$  is the adjoint of  $T$ .

One may write  $f' = \sum_{i=1}^n c_i q_i$  and (2) then is equivalent to a

system of linear equations in the  $c_i$ ,  $i = 1, 2, \dots, n$ .

Let  $\{\phi_k\}$ ,  $k = 1, 2, \dots$  denote a complete orthonormal set in  $H$  and for any  $h \in H$  let  $h = \sum_{k=1}^{\infty} h^k \phi_k$ . Now con-

sider the subspaces of dimension  $n$  spanned by sets of  $n$  of the  $\phi_k$ 's. The collection of these subspaces is denumerable and can thus be put into one-to-one correspondence with the positive integers  $J = 1, 2, \dots$ . Let  $E^{(J)}$  denote the projection operator defined as  $E^{(J)}h = \sum_{i=1}^n h^{\ell_i} \phi_{\ell_i}$

where  $J$  is the integer corresponding to the subspace spanned by  $\{\phi_{\ell_1}, \phi_{\ell_2}, \dots, \phi_{\ell_n}\}$ . Consider the projected equations related to  $Tf = g$ , namely

$$(3) \quad E^{(J)}Tf = E^{(J)}g, \quad J = 1, 2, \dots$$

If (3) has a unique solution in  $M_q$  denote it by  $f^{(J)}$ . Otherwise  $f^{(J)}$  may be any element in  $H$ .

Finally let  $P$  denote the matrix whose element in the  $i$ th row and  $j$ th column is  $p_j^i$  and let  $P^{(J)}$  denote the  $n \times n$

matrix formed from the  $n$  rows of  $P$  corresponding to the integer  $J$  in the same manner as above. The main result of this thesis is that

$$(4) \quad f' = \sum_{J=1}^{\infty} \frac{[\det P^{(J)}]^2}{\det (P^*P)} f^{(J)}$$

where  $\det C$  denotes the determinant of the matrix  $C$  and  $C^*$  denotes the conjugate transpose of  $C$ . Moreover since (as is shown in this thesis)  $\sum_{J=1}^{\infty} [\det P^{(J)}]^2 = \det (P^*P)$  the

relation (4) exhibits the least norm solution  $f'$  as a weighted average of the solutions of (3) in  $M_q$ . The  $f^{(J)}$  which are arbitrary make no contribution in (4) since if for some  $J$ , (3) does not have a unique solution then  $\det P^{(J)} = 0$ . Microfilm \$2.00; Xerox \$3.00. 58 pages.

#### ENRICHMENT FOR SUPERIOR NINTH GRADE ALGEBRA STUDENTS

(Publication No. 24,490)

William Glenn Stokes, Ph.D.  
George Peabody College for Teachers, 1957

Major Professor: F. Lynwood Wren

##### The Problem

The purpose of this study was to examine a method of providing enrichment for superior ninth grade algebra students in heterogeneous classes. There were two major objectives. The first was the preparation of enrichment material suitable for use with superior ninth grade algebra students. The second was the investigation of the effect of allowing superior students to be absent from class one day each week to work, without teacher supervision, on the material. The procedure was studied by means of standardized tests, in the following areas: (a) algebra achievement, (b) general mathematical competence, and (c) understanding of mathematical concepts. Subjective evaluations of the plan were made through the experimenter's observations and through questionnaires completed by participating teachers and students. A minor objective of the study was the investigation of the effect of the procedure on the non-superior students.

##### The Experimental Procedure

Students from seventeen ninth grade classes in six Tennessee schools took part in the experiment. Superior students from the algebra classes in three randomly selected schools made up the superior group of experimental students. The superior students from the classes in the remaining three schools made up the control group. Experimental and control groups of non-superior students were made up of the remaining students in the classes. Early in the school year all classes were given the Lorge-Thorndike Intelligence Test, the Davis Test of Functional Competence in Mathematics, and the Suelz Test of Quantitative Understandings. Minimum scores for inclusion in the superior groups were an I. Q. score of 120 and a rank of the seventy-fifth percentile or above on the Davis Test.

Thirty-eight students made up the experimental superior group and thirty-five the control group. Approximately three hundred students made up the non-superior groups.

The enrichment material prepared for the study consisted of twenty-five units of material designed to extend or supplement the classwork or new material of a type usually not studied in regular classes. The units were self-administering, consisting of a brief introduction to a concept, examples, questions, problems to be done by the student, and references.

Near the close of the school year the Davis and Suelz Tests were readministered to all students. The Lankton First-Year Algebra Test was also given at that time. From the test data, the following comparisons were made between experimental and control groups of superior students and between experimental and control groups of non-superior students: (a) gain on the Davis Test, (b) gain on the Suelz Test, and (c) Lankton Test scores. Analysis of covariance was used with the effect of intelligence held constant.

##### Results

An analysis of the test results indicated that the superior students provided with enrichment gained more in general mathematical competence during the progress of the experiment than did superior students who were not offered enrichment. There was no difference between the two groups in gain in understanding of mathematical concepts. The experimental students scored significantly higher in algebra achievement, even though they were absent from class one-fifth of the time.

The test results indicated no difference between the two groups of non-superior students in regard to gain in general mathematical competence or understanding of concepts. The experimental group of non-superior students did show significantly higher achievement in algebra.

There are indications that the enrichment material provided sufficient motivation for its study, and that it contributed to greater student interest in mathematics. This method of providing enrichment appears to be administratively possible and to give at least one way of meeting individual differences.

Microfilm \$2.60; Xerox \$9.00. 198 pages. Mic 58-5078

#### UNBIASED REGRESSION ESTIMATORS AND THEIR EFFICIENCIES

(L. C. Card No. Mic 58-3024)

William Howard Williams, Ph.D.  
Iowa State College, 1958

Supervisor: H. O. Hartley

In sample surveys one desires unbiased estimators of population characteristics such as the mean or total, and that these estimates be made with good precision. There are many methods of improving precision such as stratification of the population and judicious choice of the sampling units. The one of interest in this thesis is, however, the use of auxiliary information. This information is data

obtained on the observational units in addition to the characteristic under study. Usually it is assumed that the population mean or total of these auxiliary variates is known. In particular this thesis considers regression type estimators.

The common regression estimator of the population mean used in sample surveys is obtained by evaluating the line of best fit at the point  $\bar{X}$ . It is assumed that the regression function is linear, of the form  $A + Bx$  and that the observed values follow the stochastic model  $y_i = A + Bx_i + e_i$  where the  $e_i$  are random errors which have expectation zero, common variance and are uncorrelated with each other. The  $x_i$ 's are unspecified and are observable without error. The estimator  $\hat{y}_b$  of the population mean  $\bar{Y}$  is then of the form  $\hat{y}_b = \bar{y} + b(\bar{X} - \bar{x})$  where  $\bar{y}$  and  $\bar{x}$  are sample means and  $b$  is the least squares form of the regression slope.

If the paired observations  $y_i, x_i$  satisfy the above linear model then  $\hat{y}_b$  has expectation  $\bar{Y}$ . However, it is often unrealistic to assume that such a model is satisfied by the data and in such an event  $\hat{y}_b$  will usually be biased. Then the expectation of  $\hat{y}_b$  is given by  $\bar{Y} - \text{Cov}(\bar{x}, b)$  so that  $-\text{Cov}(\bar{x}, b)$  is the bias.

If an unbiased estimator of  $\text{Cov}(\bar{x}, b)$  could be formed, an unbiased regression estimator of  $\bar{Y}$  could then also be obtained. This estimator of  $\text{Cov}(\bar{x}, b)$  cannot be obtained from a single sample and this suggests an analytic split of the sample.

Two conditional arguments are presented, both of which lead to the same set of unbiased regression estimators. For a split of the sample into  $k$  groups an unbiased regression estimator of the population mean  $\bar{Y}$  is

$$\bar{y} + \bar{b}(\bar{X} - \bar{x}) + (1 - \frac{n}{N}) \frac{1}{k} \frac{1}{k-1} \sum_{i=1}^k (b_i - \bar{b})(\bar{x}_i - \bar{x})$$

where  $\bar{x}_i$  is the mean of the  $i$ th split of the sample and  $b_i$  has the form of the least squares estimator of a regression slope computed from the  $i$ th group only. Also  $\bar{b}$  is the mean of the  $b_i$   $i = 1, 2, \dots, k$ .

The argument used to derive these unbiased estimators are independent of the form of the  $b_i$ . Another method of estimating the regression slope is the method of group averages. The sample is split into three groups, an upper, lower, and middle group on the basis of the ordered  $x$  observations. The regression slope is then estimated by the ratio of the differences of the  $y$  and  $x$  means of the two extreme groups.

The optimum number of groups that the sample should be split into is discussed both for the least squares form of the regression coefficient and for the group average form. Also the efficiency of these two estimators is compared with the least squares method of estimation when it is known to be applicable and hence possesses certain optimum properties. The efficiencies of the unbiased estimators compare favorably.

Finally the unbiased estimators are generalized to the case of  $p$  auxiliary variates and a method of variance estimation is presented.

Microfilm \$2.00; Xerox \$5.00. 100 pages.

# A POWER STUDY OF MULTIPLE RANGE AND MULTIPLE F TESTS

(L. C. Card No. Mic 58-3797)

Russell Lowell Wine, Ph.D.

Virginia Polytechnic Institute, 1955

In recent years, many multiple comparisons tests have been presented for testing differences between pairs of means or comparisons among more than two means from a set of  $n$  sample means,  $m_1, m_2, \dots, m_n$  from normal populations. For a given experiment, it is important to know which test (or tests) is best. Before it can be decided which of two multiple comparisons tests is best, a basis for such a comparison is required.

In place of the usual power function used to compare two tests when testing the difference in a pair of means, a set of  $n(n-1)$  power functions is introduced for testing differences between pairs from a set of  $n$  means. Thus, a power vector with  $n(n-1)$  components is used to measure power at a point in the space of true differences. An average weighted power for this vector is defined to denote the power at a point.

Before power expressions are formulated for a class of multiple range tests, the region of integration is carefully described. This first required finding the equations of the bounding planes (lines). The power functions are written as an algebraic sum of integrals with limits involving the variables of integration. Each term in the power function is broken up into several parts and transformed, making the lower and upper limits of integration constant and infinite, respectively, so that each transformed integral may be evaluated by series expansion.

Since the amount of calculation necessary to find power for four or more means is so great, an approximation method is introduced to find an upper and lower bound to power in the range tests. For a class of multiple F tests, numerical integration is used when there are three means. As is shown in the Appendices, these approximations prove to be very close to the correct value.

For a clearer understanding of some of the properties of multiple comparisons tests, it is desirable that the number of decision patterns and the number of decision sets in the sample-space be determined. The enumeration of the decision patterns is described in III.

Each of the  $\binom{n}{2}$  pairwise comparisons of  $n$  means, for example  $m_1$  and  $m_2$  shows a preference for  $m_1$ , a preference for  $m_2$ , or no preference between  $m_1$  and  $m_2$  which is written as  $m_1 m_2$ ,  $m_2 m_1$ , or  $\underline{m_1 m_2}$ , respectively. In general, for any two means, the mean written to the left is preferred if they are not joined by a common underline, and there is no preference if they are joined by a common underline. On comparing  $n$  means, there are many possible patterns of underline which show preference or no preference of each of the  $\binom{n}{2}$  pairs of means. Recursion formulas are derived which give the total number of such patterns. Microfilm \$2.00; Xerox \$7.00. 147 pages.

## MINERALOGY

### SOME OPTICAL AND STRESS-OPTICAL PROPERTIES OF SYNTHETIC RUBY

(L. C. Card No. Mic 58-3707)

Joseph Anthony Mandarino, Ph.D.  
University of Michigan, 1958

The work described in this study has two main objectives: 1) a detailed study of absorption and biabsorption in pink and red synthetic ruby and 2) a study of the piezobirefringence and piezobiabsorption in pink synthetic ruby subjected to a stress parallel to the c-axis.

In the first part, the absorption coefficients for both the ordinary and extraordinary vibration directions were measured with the aid of a Cary Spectrophotometer. The results of these measurements show that the main absorption peak for the ordinary ray occurs at  $560\text{ m}\mu$  for both pink and red synthetic ruby. The main absorption peak for the extraordinary ray (for both pink and red synthetic ruby) occurs at  $550\text{ m}\mu$ . The positions of these absorption peaks are consistent with the positions of the absorption peaks in various substances investigated by Vogel; namely, synthetic and natural ruby, synthetic spinel colored by chromium, and certain solutions of chromium salts. From these examples it appears that the main absorption peak (due to chromium) in substances of relatively low optical anisotropy and absorption is independent of the internal structure of the substance.

Biabsorption, the difference between the optical absorption coefficient for the extraordinary vibration direction and that of the absorption coefficient for the ordinary vibration direction, was measured directly by a visual-matching method. The values thus obtained agree very well with the values calculated from the values of the two absorption coefficients. The maximum negative ( $k_{\omega} > k_{\epsilon}$ ) value of biabsorption, for both the pink and red samples,

occurs at a point between  $560\text{ m}\mu$  and  $570\text{ m}\mu$ . Thus, in the case of the synthetic corundum studied, the biabsorption peak occurs at approximately the same point at which the chromium absorption peak occurs.

In addition to the measurement of the absorption coefficients and the biabsorption, the indices of refraction for both pink and red synthetic ruby were measured by the method of minimum deviation. The data from these measurements are consistent with the data obtained by Kebler and Melcher. The dispersion of the indices of refraction with respect to wave length is normal.

In order to develop absorption and biabsorption surfaces for red synthetic ruby, the values of  $k_{\epsilon}$  were measured at  $10^{\circ}$  intervals of wave normal direction in a red synthetic ruby sphere. The measured values of  $k_{\epsilon}$  are, within the probable error of measurement, equal to the values derived theoretically. The values of biabsorption for  $10^{\circ}$  intervals of wave normal direction were calculated from the measured and theoretical values of  $k_{\epsilon}$  and  $k_{\omega}$ . Once again, the two sets of data agreed very closely.

The relationship between the absorption coefficients ( $k_{\omega}$  and  $k_{\epsilon}$ ) and  $\text{Cr}_2\text{O}_3$  content is consistent with Bouguer-Beer's law for  $\text{Cr}_2\text{O}_3$  contents up to 1.40%. Likewise, a linear relationship between biabsorption and  $\text{Cr}_2\text{O}_3$  content was found for the samples used in the study.

In the second part of this study, stresses were applied parallel to the c-axis of a rectangular parallelepiped of pink synthetic ruby. The piezobirefringence constant  $q_{33}-q_{11}$  was measured for a series of wave lengths and the dispersion was determined. With increasing stress, biabsorption was found to increase throughout the spectral region investigated. In addition, the biabsorption peak was found to shift towards the longer wave lengths. This latter phenomenon is probably due to a differential shift of the ordinary and extraordinary absorption peaks.

Microfilm \$2.00; Xerox \$6.00. 123 pages.

## MUSIC

### THE RELATION OF MATURATION AND OTHER FACTORS TO ACHIEVEMENT IN BEGINNING INSTRUMENTAL MUSIC PERFORMANCE AT THE FOURTH THROUGH EIGHTH GRADE LEVELS

(L. C. Card No. Mic 58-2786)

William F. Cramer, Ed.D.  
The Florida State University, 1958

The purpose of this study was to determine the relation of maturation, as it is understood in the area of child development, to achievement in beginning instrumental music performance at the fourth through eighth grades. Other factors were also investigated for degrees of relationship. From a survey of the literature, the fourth through eighth grades were determined as being the most significant for this study.

For the experimental part of the study, sixty-four students from the fourth through eighth grades of the Demonstration School of Florida State University were assigned to classes of brass-wind, wood-wind, and stringed instruments for purposes of class instruction on instruments of their own choosing. Classes met daily, through a full school year, in forty-five minute periods of traditional class instruction given by specialists of the three groups represented.

At the termination of this instructional period, students were given a series of tests for purposes of determining: (1) the degree of correlation between certain measures of physical growth and motor development and achievement in beginning instrumental music performance, (2) a level of maturity at which it is most feasible to begin the study of instrumental music, and (3) the degree of correlation between achievement in beginning instrumental music

performance and each of the following: pitch discrimination, rhythm discrimination, tonal memory, mental age, personality adjustment, and the total amount of actual playing experience on any musical instrument.

The Watkins Objective Measurement of Musical Performance was used as the measure of musical achievement. All other measures or tests were correlated with it by the Pearson product-moment technique using ungrouped data.

Maturation was determined (1) by taking certain measurements of physical growth and defining them by the Wetzell Grid Technique, the Olsen and Hughes Manual, and (2) by administering the Van der Lugt Psychomotor Test Series for Children.

Additional tests and measurements used included the Seashore Measures of Pitch Discrimination, Rhythm Discrimination, and Tonal Memory, the Kuhlman-Anderson Intelligence Tests, the Rogers Personality Adjustment Test, an evaluation of instrumental motor performance by a panel of three judges, and an evaluation of the actual length of time each student had been playing musical instruments. All the data were correlated with the Watkins Performance Test.

On the basis of this research experiment and supporting literature, the following hypotheses were accepted:

1. Successful achievement in instrumental music performance at the fourth through eighth grade levels is significantly influenced by the motor development of the individual student.

2. The seventh grade level is indicated as the time when optimum maturational conditions are present for the beginning of purposeful study of instrumental music.

3. Successful performance in instrumental music is also accompanied by high standing in intelligence, pitch discrimination, rhythm discrimination, tonal memory, and personality adjustment.

4. Successful performance in instrumental music is not necessarily dependent upon previous playing experiences.

The following hypothesis was rejected:

1. Achievement in beginning instrumental music performance at the fourth through eighth grade levels correlates significantly with physical growth.

The data do not indicate the use of any of the tests as reliable predictive devices. The study is to be regarded as exploratory; consequently, certain applications and implications have been indicated.

Microfilm \$2.00; Xerox \$4.60. 88 pages.

#### THE EXTENT OF AGREEMENT IN ATTITUDES TOWARD MUSIC EDUCATION PRACTICES AMONG SOUTHERN ILLINOIS HIGH SCHOOL STUDENTS AS MEASURED BY KENDALL'S 'TAU'

(L. C. Card No. Mic 58-2788)

Robert Bernard Forman, Ed.D.  
The Florida State University, 1958

The purpose of this study was to report the attitudes of students as those attitudes relate to specific music education practices. The study indicates the amount of importance attached to various music education practices by the

different strata of the respondents. Furthermore, it investigates the amount of agreement regarding the relative importance of certain practices which exist between various classifications of the students.

The hypotheses were: (1) that the ability of high school students to indicate attitudes toward music education practices is real, and the measurement of such attitudes can be statistically reported, and (2) that students in music differ from students not in music with respect to their expressed attitudes toward music education practices.

The questionnaire content was based on the statements found in the Consensus Study Number Seven developed by the Illinois Secondary Schools Curriculum Committee. It consists of twenty-six statements which were ranked in terms of their relative importance, using the numbers from one to twenty-six. The sampling included the total high school student enrollments in six accredited high schools of Southern Illinois. The marking of the questionnaires was carried out in each school under the personal direction of the author. The total number of usable returns was 1047.

The results indicate that the ranking of the items was done with deliberation. The attitudes of the respondents toward music education practices were measurable and were statistically reported. The evidence does not support or negate any significant difference between attitudes of Students in Music and Students not in Music.

The students considered it most important that the high school music program teach students to play instruments, teach basic music fundamentals, give special attention to talented students, teach students how to sing, and provide programs for the community. The students considered it of least importance that the school music program be financially self-supporting, explain the fundamentals of baton twirling, teach songs which will be sung years later, discuss various aspects of jazz music, and make other school subjects more meaningful.

A significant part of the study was the use of the correlation method devised by Kendall and referred to as Tau. Previous use of the Tau Coefficient has been limited to a small 'n'; however, in the present study, the use of IBM equipment made it possible to disregard this limitation.

The questionnaire provides a basis for consideration of questionable as well as meaningful music education practices.

Microfilm \$2.80; Xerox \$9.60. 213 pages.

#### THE DEVELOPMENT OF TWO EXPERIMENTAL SOUND FILMS IN TEACHING ELEMENTARY MUSIC

(L. C. Card No. Mic 58-2982)

Raymond H. Stevens, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Neal E. Glenn

Statement of the problem. It was the purpose of this study to ascertain if a sound film (1) could teach a new song directly to a classroom audience and in so doing (2) could continue to hold the attention and interest of the viewing audience. In addition, the necessity of including elementary school children in the film to help in audience identification was explored.

**Related studies.** Three areas related to this project were examined: research on sound films, methods and procedures in elementary music education, and current sound films relating to elementary music. Most of the techniques for the presentation and production of this writer's two experimental films were the result of a review of recent studies carried on by The Pennsylvania State College. In addition, the philosophy and procedures proposed by such music educators as Mursell, Myers, Glenn, and Nye were utilized.

**The project.** Two experimental films were produced with the cooperation of the Bureau of Audio-Visual Instruction of the State University of Iowa. The first film, *Chester*, approximately eleven minutes long, is designed so it may be correlated with classroom studies on the American Revolutionary War. The second film, *York*, approximately seven minutes in length, is designed to correlate with classroom studies on the Pilgrims. In both films a teacher directly instructs the audience. Participation by this audience is required by the very nature of the film. The first film, *Chester*, uses three children for the purpose of audience identification. The second film, *York*, does not.

**Evaluation plan.** The music teacher or regular class teacher, two authorities (Dr. Neal Glenn, Associate Professor of Music, and Mr. Lee Cochran of the Bureau of Audio-Visual Instruction) and the writer observed fifth-grade children viewing both films. These observers recorded their subjective evaluations on prepared one-page questionnaires immediately after each film was shown. A total of 302 children in twelve classes were observed.

**Statement of the conclusions.** It is concluded that, in such schools as have been described in this study, i.e., small, town schools with a wide range of achievement scores, a sound film can teach a new song directly to a viewing classroom audience while holding the attention and interest of the viewing audience. In addition, it is concluded that the use of children of elementary school age in the film, *Chester*, helped the film.

Microfilm \$2.00; Xerox \$5.00. 98 pages.

#### MINIMUM PIANO REQUIREMENTS FOR MUSIC EDUCATION MAJORS: A COMPARATIVE STUDY AND EVALUATION OF PIANO COMPETENCIES

(L. C. Card No. Mic 58-2798)

Emily Elizabeth Webber, Ph.D.  
The Florida State University, 1958

Since the advent of widespread recognition of music in the public schools of the United States, minimum piano requirements for undergraduate music education majors have been a source of concern to thoughtful college music teachers. It has been the purpose of this study to present a comprehensive appraisal of these requirements through a comparative survey and evaluation of current thought, research, and practice.

The study includes:

1. the investigation, analysis, and description of:
- (a) related backgrounds in music education, (b) purposes

of piano study for the music education major, (c) minimum piano requirements recommended by national music teacher associations.

2. a survey and critical evaluation of existing requirements and administrative practices determined by questionnaire responses from 244 teacher training institutions in the United States.

3. recommendations and suggestions for developing and improving these requirements.

From the evidence provided by the investigation the following conclusions were reached.

1. While 94 per cent of the teacher training institutions reported some type of minimum piano requirement stated either as credit, levels of advancement, skills, or functional abilities, these requirements reveal extreme variation and lack of standardization.

2. Although a directional movement toward the incorporation of functional abilities into existing requirements is indicated, the three "most frequently required functional abilities" cited in item 3 below are listed for all music education majors by only 52-63 per cent of the participating institutions.

3. The most frequently required functional abilities are sight reading hymns and community songs, sight reading vocal accompaniments, and harmonizing melodies; those less frequently required, sight reading instrumental accompaniments, and transposition; and least frequently required, improvisation, and sight reading a three or four staff choral score.

4. Many institutions require music education majors to demonstrate piano competencies through proficiency examinations.

5. Some institutions are doing away with piano credit requirements in favor of stating requirements in terms of competencies to be achieved.

6. Most institutions do not: (a) have entrance requirements in piano for music education majors; (b) differentiate in the piano requirements for choral, instrumental, and general majors; (c) employ special piano teachers or offer special piano courses designed for music education majors.

7. Most institutions offer keyboard harmony in an integrated theory course required of all music majors.

8. Approximately one-half of the institutions offer class piano for music education majors.

9. Administrative practices used to implement and enforce requirements show extreme variation.

10. Most questionnaire respondents support the basic concept of functional minimum piano performance requirements for music education majors, but approximately one-third indicate that their institutions lack success in implementing and/or enforcing such requirements.

From an overall evaluation of minimum piano requirements for music education majors, it was concluded that functional minimum piano requirements for all music education majors and functional programs of piano instruction are necessary if teacher training institutions are to insure the development of the pianistic competencies needed by the well-qualified music teacher in today's schools. While progress has been made, much remains to be done by teacher training institutions in the formulation, implementation, and enforcement of these requirements.

Microfilm \$2.45; Xerox \$8.60. 188 pages.

## PHARMACOLOGY

### THE PAPILLARY MUSCLE PREPARATION AS A METHOD FOR THE STUDY OF POSITIVE INOTROPISM

(L. C. Card No. Mic 58-3636)

Donald Raymond Bennett, Ph.D.  
University of Michigan, 1958

The first major division of this thesis is a study of the papillary muscle preparation, directed at reducing the variation in response among papillary muscles to the cardiac glycosides and other myocardial stimulants. The second major division is an investigation of 4-substituted-2,3-unsaturated acids and lactones for their ability to produce a positive inotropic action.

Both isometric (transducer-cathode ray oscillograph) and isotonic (heart lever kymograph) methods of recording were employed. Modifications of the muscle holder, media, preparation of the muscle, and method of stimulation were made to effect a more adequate preparation with respect to constancy of response. The effect of different diastolic tensions on the work response of the eudynamic and drug stimulated hypodynamic papillary muscle was investigated in the isotonic method of recording. The following conclusions can be drawn from this study.

The response of the papillary muscle to increasing intensity of stimulation whether this be graded or all-or-none, is markedly dependent upon electrode placement. Diastolic tension markedly affects the response, expressed as a percentage of the control contractile amplitude, of a hypodynamic papillary muscle to the stimulant actions of calcium, sodium fluoride, and ouabain, but has no influence on the stimulant action of epinephrine. The response of a hypodynamic papillary muscle to ouabain appears to be the same whether contracting isometrically or isotonicity, and is independent of the degree of failure in the range of 20 per cent to 70 per cent of the original maximum control amplitude. The papillary muscle is capable of withstanding a long period of anoxia without irreversible change in contractility. Ouabain is ineffective in stimulating a papillary muscle depressed by anoxia, but reverses additional pentobarbital induced failure.

A number of compounds, closely related chemically to the opened-ring structure of the lactone of the cardiac glycosides have been found to possess a digitalis-like positive inotropic action on isolated hypodynamic mammalian myocardium. The basic chemical nucleus necessary for activity is a conjugated double bond system,  $R - CH = CH - CO - R'$ . A cross conjugated double bond system,  $R - CO - CH = CH - CO - R'$  where R and R' are both methyl yields the most active compound in this series (diacetyl-ethylene). Compounds with the following structure,  $X - CH_2 - CH = CH - CO - R$  also possess considerable activity. Activity in all structures is retained if the C-C double bond is substituted by an acetylenic bond, but is abolished if saturation of the double bond is effected. Some evidence suggests that maximum activity is obtained with the *cis* configuration of the double bond. Some of the more active compounds found in this study are acrolein, methyl vinyl ketone, methyl 4-iodocrotonate, methyl 3-acetyl-

acrylate, 4-acetoxy-4-hydroxy-2-pentenoic acid lactone, and 1-hexyn-3-one. The character of the positive inotropic action is similar to that obtained with the cardiac glycosides in this preparation. Only hypodynamic myocardium is stimulated. Stimulation may persist for hours, and with sufficient concentration, contracture is ultimately produced. The toxic actions of the cardiac glycosides in this isolated preparation; spontaneity, arrhythmias, and depressed irritability, have not been observed with these agents.

These data are discussed with respect to the present concepts of the mechanism of the positive inotropic action of the cardiac glycosides.

Microfilm \$2.00; Xerox \$5.60. 115 pages.

### THE EFFECTS OF CERTAIN SUBSTANCES OF NEUROHUMORAL SIGNIFICANCE ON SPINAL CORD REFLEXES

(L. C. Card No. Mic 58-3688)

John Walter Kissel, Ph.D.  
University of Michigan, 1958

The effects of various substances of neurohumoral significance were determined in cats on three spinal cord reflexes: a) the patellar reflex, b) crossed extension, and c) ipsilateral inhibition of the patellar reflex. Since many of the drugs studied have marked vascular actions, an attempt was made to separate their direct neuronal from their secondary neurophysiological effects due to vascular changes in the spinal cord. This was done by studying the possible modifications of these reflexes by 1) arterial blood pressure stabilization at different levels, 2) various drugs before and after blood pressure stabilization, 3) asphyxia or spinal cord hypoxia, and 4) autonomic blocking or potentiating agents. These methods partially enabled the separation of vascularly induced reflex alterations from directly induced changes. With drugs which either failed to alter vascular smooth muscle or which tended to dilate blood vessels, maintenance of adequate blood pressure by stabilization was sufficient to separate the above effects. With drugs which induced vascular constriction it was necessary to employ smooth muscle blocking agents in conjunction with arterial pressure stabilization.

Asphyxia induced by a variety of procedures was found to increase or decrease the patellar and crossed extensor reflexes. The results depended upon the speed of induction and severity of the asphyxia.

Epinephrine and norepinephrine were found to produce two types of response. The most frequent was phasic and characterized by alternations of inhibition and augmentation of the patellar reflex, the second period of enhancement sometimes being accompanied by convulsant activity. Crossed extension remained unchanged except during the period of hyperreflexia. The second type of response was seldom seen and consisted of simple gradual inhibition of

the patellar reflex followed by gradual recovery. These responses were interpreted as resulting primarily from a direct action on neuronal tissue.

Serotonin produced a sequence of inhibition and augmentation of both the patellar and crossed extensor reflexes. The effect was not a result of vascular changes. It was caused by either a direct central action of serotonin or by the stimulation of peripheral receptors.

Alterations of spinal reflexes by acetylcholine were primarily vascular in origin. However, after blood pressure stabilization the injection of acetylcholine following the administration of cholinesterase inhibitors caused a prolongation of crossed extension and the appearance of spontaneous activity in the hindlimb. The relative ineffectiveness of acetylcholine given intravenously in enhancing crossed extension was apparently due to its inability to penetrate with ease the blood-brain barrier. Physostigmine was found to augment markedly both the patellar and crossed extensor reflexes. It was very effectively antagonized by atropine, but not by atropine methyl nitrate.

Neostigmine was primarily peripheral in its action and was more effectively antagonized by atropine methyl nitrate than by atropine. These effects were not of vascular origin. Arecoline exhibited stimulant actions on both the patellar and crossed extensor reflexes that were independent of blood pressure changes. Like physostigmine, arecoline was more effectively antagonized by atropine than by atropine methyl nitrate. These findings suggest the presence of cholinergic facilitatory interneurons in the spinal cord.

Histamine produced only inconsistent and depressant effects on spinal reflexes and the systemic circulation. Substance P appeared devoid of activity on spinal cord reflexes when administered intravenously. These substances do not appear to be of any neurohumoral significance insofar as these reflexes are concerned.

None of the substances studied appeared to affect ipsilateral inhibition of the patellar reflex.

Microfilm \$2.00; Xerox \$6.20. 130 pages.

## PHILOSOPHY

### MEANING, ONTOLOGY, AND INTENSIONAL CONTEXTS

(L. C. Card No. Mic 58-2961)

Reinhardt Siegbert Grossmann, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Gustav Bergmann

This dissertation attempts a critical evaluation of some recent and contemporary publications on intensionality and meaning and suggests solutions for some of the philosophical problems concerning these topics. The first chapter contains an explication of the three terms of the title and explains the method of philosophy adopted for the remainder of the thesis. In the second chapter, the author reviews Frege's and Russell's early attempts to transcribe intensional contexts into a clarified language. It is shown in detail how Frege's introduction of the sense-denotation dichotomy leads to a redundant ontology which embraces senses as entities on a par with denotations. Russell's theory of definite descriptions, on the other hand, is understood to eliminate one of the sources for Frege's ontology. However, it is also contended that Russell's early publications, aside from introducing a distinction between primary and secondary scope for descriptions in intensional contexts, do not solve all the problems discovered by Frege. The third chapter introduces the latter day "Fregeans", Church, Carnap, and Lewis. It con-

tains a critical analysis of their views. In particular, Church's improvements of Frege's system are charged with yielding no satisfactory criteria for identity of senses and no acceptable answer to Mates criticism. It is submitted that Carnap's construction of a "neutral" metalanguage can not escape the acceptance of an ontology of senses. The fourth chapter contains a similar evaluation of some recent attempts to solve the philosophical problems of intensionality and meaning within a Russellian rather than a Fregean framework. It is shown that contrary to Quine's view, substitutivity offers no difficulties for modal contexts if one follows Russell's and, more recently, Fitch's and Smullyan's suggestion and distinguishes between the primary and secondary scope of descriptions and class abstracts. The author concludes from this part of his analysis that the modal problem can be solved without the Fregean double-tie view of meaning. Goodman's and Scheffler's views are examined and criticized. In the last chapter, the author divides the problem of belief contexts into two parts. It is shown that certain belief contexts can be transcribed behavioristically into a nonintensional language of the kind of PM', that is, PM with descriptive constants added. This solves the first part of the problem. It is furthermore suggested that a solution of the remaining part can be given along the line recently proposed by Bergmann. This necessitates the introduction of two new undefined logical constants.

Microfilm \$3.25; Xerox \$11.20. 252 pages.

## PHYSICS

### PHYSICS, GENERAL

#### STARK AND ZEEMAN EFFECT STUDIES OF HCN

(L. C. Card No. Mic 58-2727)

Brojo Nath Bhattacharya, Ph.D.  
Duke University, 1958

Supervisor: Walter Gordy

The design of a parallel plate Stark Cell, suitable for observing both  $\pi$  and  $\sigma$  transitions, is reported. Observations on both the components in the specific case of  $\text{HCN}^{14}$  are described. One line due to  $\Delta M = 2$  transition has been observed in the case of  $\sigma$  components. Both the  $\sigma$  and  $\pi$  components show anomalous splitting at high fields which cannot be explained on the basis of the calculations of Fano. Arguments are forwarded to show that the anomalous splitting is due to a breakdown of the  $|M|$  degeneracy caused by mixing of excited orbitals. The best value of the dipole moment of  $\text{HCN}^{14}$  from present observations is found to be  $2.984 \pm .002$  Debyes.

The thesis also incorporates a report on the Zeeman Effect studies of  $\text{HCN}^{14}$ . Data on both the  $\pi$  and  $\sigma$  components in the intermediate field case are reported. The value of  $g_J$  is found to be .0962. Nuclear Magnetons for  $\text{HCN}^{14}$ . Calculation of

$$\sum_{\eta} \frac{|\langle 0 | L_z | \eta \rangle|^2}{E_{\eta} - E_0}$$

from the "Cosine" interaction and from  $g_J$  on the basis of White's work shows reasonable agreement.

Microfilm \$2.00; Xerox \$4.80. 92 pages.

#### PHOSPHORESCENCE STUDIES OF ORTHO-, META- AND PARA-XYLENE AT LOW TEMPERATURES

(L. C. Card No. Mic 58-2728)

Lawrence Avery Blackwell, Ph.D.  
Duke University, 1958

Supervisor: H. Sponer

The triplet-singlet emission spectra of the xylenes in the crystalline state at  $77^\circ\text{K}$  and at  $4^\circ\text{K}$  and in a rigid glass at  $77^\circ\text{K}$  have been photographed and analysed. The samples used in this work were obtained from the National Bureau of Standards and were kept sealed under an oxygen-free atmosphere of helium gas throughout these experiments. Large, well-formed crystals were grown from the vapor on a surface cooled by liquid nitrogen.

At  $4^\circ\text{K}$  ortho-xylene produced two sharp spectra similar in structure and separated by  $370\text{ cm}^{-1}$  from each other. These spectra are ascribed here to the presence of

two distinct crystalline phases. Ortho-xylene did not produce a significant phosphorescence at  $77^\circ\text{K}$ . The spectrum of meta-xylene at  $4^\circ\text{K}$  consisted of a strong diffuse spectrum and a weak sharp spectrum toward shorter wavelengths. The diffuse spectrum appears to be associated with the amorphous phase. At  $77^\circ\text{K}$  a broad spectrum appeared which was seen to be characteristic of an aldehyde. Para-xylene produced a sharp spectrum at  $4^\circ\text{K}$  beginning at  $25254\text{ cm}^{-1}$  and differing in vibrational structure from the spectrum of this compound in a rigid glass. From a vibrational analysis of the spectrum it was concluded that the carrier of this spectrum is para-methylbenzaldehyde. The excitation mechanism of the crystal phosphorescence of these compounds is discussed.

Microfilm \$2.00; Xerox \$3.60. 64 pages.

#### THE THERMAL EXPANSION OF ARTIFICIAL POLYCRYSTALLINE CARBONS AND GRAPHITES

(L. C. Card No. Mic 58-2891)

Franklyn M. Collins, Ph.D.  
The University of Buffalo, 1958

The purpose of this work has been to investigate changes in the thermal expansion of fabricated, polycrystalline carbons in relation to variations in the method of their preparation. Experiments were performed by carefully varying conditions in the preparation of carbon specimens from standard raw materials and measuring the resultant differences in the thermal expansion of the products.

Measurements of thermal expansion were performed in the range from room temperature to  $2800^\circ\text{C}$  using two different instruments for the high and for the low temperature ranges. For measurements in the range from  $0^\circ$  to  $800^\circ\text{C}$  a quartz dilatometer with a sensitive mechanical dial gauge was employed. To obtain data in the range between  $800^\circ$  and  $2800^\circ\text{C}$  a pair of short-range telescopes equipped with micrometer eyepieces were mounted outside observation ports of a graphite tube furnace. Due to the anisotropy of fabricated carbons, specimens for measurement had to be cut in different directions from each graphite body studied. The coefficient of volume expansion (volume C.T.E.) was computed from the linear C.T.E. for the purpose of comparison. Carbon samples were fabricated by molding or extruding mixtures of ground coke and an organic binder (such as coal-tar pitch) and subsequently baking the formed article to carbonize the binder.

Although all the samples were finally baked to a common temperature of  $2700^\circ\text{C}$ , the volume C.T.E. of fabricated carbons was found to be markedly dependent on the maximum temperature to which a coke was heated (calcination temperature) prior to grinding and further processing. Carbons made from cokes which had been calcined to lower temperatures, in the range from  $500^\circ$  to  $1350^\circ\text{C}$ , were found to have relatively high thermal expansions, with the exception of carbon made from Texas coke calcined to  $500^\circ\text{C}$ .

The volume C.T.E. was found to be inversely related to the average size of the coke particles (within the range 0.01 mm to 4 mm).

Carbons which were prepared with a higher density by molding the coke-binder mix under a greater pressure were found to have a slightly higher thermal expansion: a 45% increase in density was accompanied by a 13% increase in volume C.T.E.

The contribution of the binder to the thermal expansion of the aggregate was investigated by varying the coke-to-binder ratio. For a given packing density of coke particles, the thermal expansion of an aggregate was found to be somewhat lower for a larger proportion of binder. However, when the binder content of a baked carbon was increased by subsequent impregnation with fluid pitch and rebaking, the thermal expansion was substantially increased.

The thermal expansion of different specimens of coke was also investigated. The volume C.T.E. of two-inch-long specimens of a coke derived from crude oil (the type used commercially for the production of graphite) was found to be exceptionally small ( $1.5 \times 10^{-6}$  per  $^{\circ}\text{C}$ ) in comparison with the volume C.T.E. for pieces of the same coke about one-eighth-inch in size ( $8.4 \times 10^{-6}$  per  $^{\circ}\text{C}$  on the average).

The thermal expansion of one-eighth-inch coke pieces which were cut from raw coke and subsequently calcined was found to be about 25% lower than that of similar pieces which were prepared from coke which was calcined first and then cut.

The thermal expansion of individual one-eighth-inch coke pieces which were impregnated with pitch and baked was found to be from 25% to 50% higher than the thermal expansion before impregnation. The increase in the C.T.E. depends on the calcination temperature of the coke which was impregnated.

The thermal expansion of fabricated carbons was found to vary by as much as 60% as a consequence of changes in the procedure used in their preparation from standard raw materials. The results indicate that the functions of the filler and of the binder in determining the thermal expansion of bonded carbon aggregates are different, and that these functions are interrelated through an influence of the binder on the coke particles.

Additional results were obtained concerning the variation of thermal expansion with 1) the ambient temperature of measurement, 2) the temperature of heat treatment of the carbon, and 3) the introduction and removal of interstitial bisulfate ions. The nature of the correlation between the anisotropies of the thermal expansion and magnetic susceptibility was also investigated.

Microfilm \$2.00; Xerox \$5.00. 96 pages.

#### APPROXIMATE METHODS FOR THE CALCULATION OF THE SCATTERING OF PARTICLES BY ATOMS AND NUCLEI

(L. C. Card No. Mic 58-2892)

Alexander H. Flax, Ph.D.  
The University of Buffalo, 1958

Approximate methods for calculating the phase shift in the scattering of particles by a short-range potential field

have been studied in this thesis with particular emphasis on methods suitable for use when the Born series fails to converge. A method for extending the radius of convergence of the Born series has been developed. It turns out, however, that this method reduces to essentially the same result as the variational methods of Hulthén, Kohn and Schwinger, when applied in its simplest form. At a minimum it requires the calculation of the second Born approximation.

It is shown that the Schwinger variational method applied to one-signed potentials is actually a maximum principle (i.e., it gives values of phase shift always less than the exact value) inside the radius of convergence of the Born series. The Hulthén and Kohn methods share this property only at zero energy for general potentials, and

for  $ka \leq \frac{\pi}{2}$  for potentials cut off at a radial distance  $a$ ,

where  $k$  is the wave number of the incident particle. The even-numbered Born approximations also have this property for one-signed potentials. For potentials which change sign, the variational principles of Hulthén and Kohn retain the maximum property at zero energy and for cut-

off potentials with  $ka \leq \frac{\pi}{2}$ , but the Schwinger variational

principle does not, nor do the even-numbered Born approximations. The latter result is a generalization and clarification of a maximum principle for scattering stated by Percival, who first box normalized the scattering problem to make the energy spectrum discrete, and related the phases as discrete values of wave number  $k$  to the energy spectrum.

At zero and very low energies, the effective range formula of Blatt and Jackson provides a means for calculating the phase shifts. By using the eigenfunctions and eigenvalues of the radial wave equation with a parameter  $\lambda$  on the potential strength, it is found that for systems having a weakly bound state, the calculations required in the application of the effective range formula can be substantially simplified. This method is applied to neutron-proton scattering and to scattering of electrons by helium atoms. In both cases good agreement with more exact calculations is shown.

Microfilm \$2.00; Xerox \$7.00. 146 pages.

#### MILLIMETER WAVE SPECTROSCOPY OF MOLECULAR BEAMS AT HIGH TEMPERATURE

(L. C. Card No. Mic 58-2732)

Allen K. Garrison, Ph.D.  
Duke University, 1958

Supervisor: Walter Gordy

Millimeter wave spectroscopy of molecular beams at high temperatures is accomplished with a microwave cell consisting essentially of a vacuum chamber containing an oven and electromagnetic horns which convey the radiation in and out of the vacuum chamber. The molecules are evaporated by the oven and sprayed into the microwave path. The microwave power entering the cell is mostly fourth harmonic from a crystal multiplier driven by a K band klystron. The absorption is detected and displayed by the usual crystal video system.

Molecular beam spectrometers of this type have the advantage that both the Doppler and pressure broadening can largely be avoided to give good resolution and precision measurements. Also, for high temperature work they solve the onerous problem of heating an entire microwave cell with its sealed windows. Furthermore, using millimeter waves and high temperature makes it possible to measure the rotation spectra of light diatomic molecules such as LiF, LiCl, NaF as well as some of the alkali hydrides and the centrifugal stretching effect of heavier molecules.

A description of the construction of the spectrometer is given as well as a discussion of its operation.

A sample calculation is carried out to illustrate various factors involved in molecular beams and resulting line intensities. Although the population of rotational states in the beam is not favorable for detecting absorptions, the high frequencies used increase the chances of success.

The  $J = 12 \rightarrow 13$ ,  $v = 0, 1, 2$  transitions in  $\text{KCl}^{35}$  were observed and measured. The frequency of the  $J = 12 \rightarrow 13$ ,  $v = 0$  and 1 transition were measured to 2 parts in  $10^7$ . The measured half-width between half power points of the  $v = 0$  line was 60 kc/sec which is a reduction by a factor of two of the Doppler half-width at  $1000^\circ \text{K}$ . The centrifugal stretching constant for  $\text{KCl}^{35}$  was computed from these frequencies and data obtained elsewhere.

The  $J = 6 \rightarrow 7$ ,  $v = 0$  transition in  $\text{NaCl}^{35}$  was also observed and its frequency measured. The centrifugal stretching constant of this molecule was also computed from this and other data.

Microfilm \$2.00; Xerox \$3.00. 57 pages.

#### X-RAY PHOTOELECTRON SPECTRA FROM THIN METAL FILMS

(L. C. Card No. Mic 58-3076)

Emmett Smith Jacobs, Ph.D.  
Lehigh University, 1958

The object of this investigation was to study, critically, the fundamental relationships involved in the generation of photoelectrons by the action of monochromatic X-radiation and to develop a new technique for measuring metal coating thickness.

Photoelectrons ejected by monochromatic X-rays may come from any shell within the atom of the sample material if the X-ray beam is sufficiently energetic. However, only those electrons from the innermost shells of the surface atoms are able to escape, since the electrons from atoms beneath the surface are completely absorbed and do not escape. Thus the photoelectron spectrum of a metal sample is characteristic of the surface of the sample.

The intensity and energy relationships of photoelectrons ejected by monochromatic X-rays were studied using a radial electrostatic field for focusing the electrons and an ultra-thin window Geiger-Muller counting tube for determining the electron beam flux. The interpretation of the mechanisms which correspond to the observed peaks in the X-ray photoelectron spectra of nickel, copper, rhodium, platinum, and gold are given. The relative intensity, the observed and the theoretical energy values are given for each peak in the Intensity-Energy spectra of these metals.

An extended theory is advanced to explain, mathematically, the generation, absorption, and the measured intensity of the electrons ejected from the surface of a sample by the action of monochromatic X-radiation. A general relationship is given to predict the relative efficiency of varying wave length monochromatic X-radiation for generating photoelectrons from the surface of any sample material. Also, a general relationship is given to predict the maximum measurable metal coating thickness as a function of the incident X-ray wave length.

A new technique is given for a direct, nondestructive method of measuring metal coating thickness. The observed photoelectron intensity variations which occur with changing metal coating thicknesses were used as a basis for determining the thickness of thin films of gold plated on a nickel base. The practical range for thickness measurements of gold coatings with X-ray photoelectrons was found to extend from slightly less than  $1 \times 10^{-6} \text{ cm.}$  to approximately  $1 \times 10^{-3} \text{ cm.}$  These values are about one hundred times less than those obtained with X-ray fluorescent measurements. The method is applicable to metal films on any base material and is independent of the base material.

Microfilm \$2.00; Xerox \$5.20. 105 pages.

#### THE INTERACTION OF PLANE AND CYLINDRICAL SOUND WAVES WITH A STATIONARY SHOCK WAVE

(L. C. Card No. Mic 58-3680)

Walter Richard Johnson, Ph.D.  
University of Michigan, 1958

This thesis presents a theoretical study of the interaction of plane and cylindrical sound waves with a stationary shock in a compressible, inviscid gas.

It is shown that a plane sound wave impinging on the shock distorts the shock, and gives rise to either a reflected or a refracted wave field, but not both. If the sound wave is incident from the subsonic side of the shock a reflected wave field consisting of a longitudinal sound wave and a transverse entropy-vorticity wave appears. A plane sound wave falling on the shock from the supersonic side, however, causes a refracted wave field consisting of a sound wave and an entropy-vorticity wave. In the latter case there is a range of incident angles for which the refracted sound field is damped. The angles of reflection or refraction are given by the appropriate generalization of Snell's laws, and the wave amplitudes are given by the corresponding generalization of the Fresnel formulae.

A study of the propagation of cylindrical sound waves in a moving medium is made, and explicit formulae for the sound potential in subsonic and supersonic flows are given. In a subsonic flow the sound potential is similar to the sound potential in a medium at rest, and reduces to this function when the Mach number is equal to zero. However, in a supersonic flow the sound disturbance is contained in the forward Mach wedge of the source; the individual wave surfaces are cylinders, asymptotic to the Mach wedge, blown downstream with the flow. These cylindrical waves exhibit a  $90^\circ$  phase jump across their lines of tangency with the Mach wedge, analogous to the  $90^\circ$  phase jump discovered by Debye for waves passing through a focal line.

The treatment of the interaction of a cylindrical sound wave with a shock is analogous to H. Weyl's treatment of the propagation of radio waves over the surface of a plane earth. The incident sound wave is represented as a superposition of plane sound waves of varying direction. Each of the plane waves in this superposition interacts with the shock giving rise to the previously determined distortion and reflected or refracted wave field; therefore the cylindrical wave causes a disturbance which may be written in integral form as a superposition of plane waves. The resulting interaction integrals are evaluated asymptotically by means of the saddle-point method to give explicit formulae for the distortion, sound field, and entropy-vorticity wave.

A line source on the subsonic side of the shock generates a cylindrical sound wave which distorts the shock and causes a reflected cylindrical sound wave and a reflected hyperbolic entropy-vorticity wave. On the other hand, a line source on the supersonic side of the shock gives rise to a refracted sound wave which is not cylindrical, but whose deviation from cylindricity is of order  $x_0/\rho$ ,  $x_0$  being the distance of the source from the shock. In this case the entropy-vorticity wave is an ellipse asymptotic to the streamlines emanating from the intersection of the Mach wedge and the shock.

Generalizations of the theory to a point source and to a moving shock are discussed, but are not worked out in detail; and proposals are made for possible future experiments in connection with the theory.

Microfilm \$2.00; Xerox \$6.80. 144 pages.

## PHOTOCONDUCTION IN SINGLE CRYSTALS OF ZnS

(L. C. Card No. Mic 58-2886)

Frank G. Ullman, Ph.D.  
Polytechnic Institute of Brooklyn, 1958

Adviser: John J. Dropkin

### I. The Electrical Behavior of Single Crystals of ZnS

As a preliminary to the work in II below, the ac and dc behavior of photoconduction in non-luminescent natural and synthetic single crystals of ZnS (with small amounts of impurities) has been investigated. Natural crystals exhibit persistent internal space charge polarization and show a Debye type of frequency dispersion in ac resistance and capacitance in the 3-50 cps range. Debye dispersion equations that include the finite dc resistance of the sample and fit the experimental results, are derived. These results except for a non-linearity with voltage are shown to be consistent with a conductivity mechanism postulated to explain similar ac and dc behavior in photoconducting phosphor powders.

Synthetic crystals are markedly different. DC polarization and ac dispersion effects are small and the speed of response is slow (approximately 30 sec.). The absence of luminescence, the small polarization and dispersion effects, and the slow response are all consistent with a picture in which large numbers of empty shallow traps act as recombination centers for the charge carriers. The steady state photocurrents obey Ohm's law up to 10,000

volts/cm. except for small deviations below about 100 volts/cm.

It is postulated that the differences in electrical behavior of these two crystal types result from the presence of deep traps in the natural crystals and their absence in the synthetic crystals.

### II. Infrared Stimulation and Quenching of Photoconduction in Single Crystals of ZnS:Cu

The spectral response of photoconduction in the synthetic crystals has been investigated from 0.5 to 2.0 micron. Two photocurrent peaks at 0.65 and 1.35 micron are found. Photocurrents are also excited by 2537A and 3650A UV and both can be quenched by IR. The crystals studied appear to be of two types. In some, the UV photocurrent is decreased by IR (quenching) while in others it is increased by IR (stimulation). In all crystals, however, the sum of the UV and IR photocurrents, measured separately, is always greater than the photocurrent excited by simultaneous UV and IR. In view of the linearity of intensity response of each separately, the existence of an IR photocurrent in the unirradiated crystal, this is interpreted as a quenching of an electron carrier UV photocurrent by a hole carrier IR photocurrent.

Excitation of IR photocurrent, IR quenching of UV photocurrent, IR absorption and also the IR quenching of fluorescence and excitation of IR emission found by others are shown to have nearly identical spectral response and therefore all probably arise from the same excitation mechanism.

These results are interpreted by a slightly modified version of the Schön-Klasens model of hole excitation by IR and hole migration to quenching centers proposed by Dropkin and Goldstein for ZnS quenching phosphors.

The dependence of both quenching and excitation of photocurrent on light intensity and temperature is shown to be in accord with this picture.

Microfilm \$2.00; Xerox \$6.40. 131 pages.

## PHYSICS, NUCLEAR

### A STUDY OF THE CONTINUOUS BETA SPECTRA ASSOCIATED WITH THE DECAY OF SEVERAL RADIOACTIVE ISOTOPES

(L. C. Card No. Mic 58-3642)

Mary Kate Brice, Ph.D.  
University of Michigan, 1958

The continuous beta spectra of ten radioactive isotopes have been investigated, using a magnetic double-focussing spectrometer with a 17-centimeter radius of curvature. Energies, relative intensities, and log ft values of the transitions have been determined. The results of the beta spectrum analyses are discussed in terms of the energy level schemes of the isotopes. A number of spin and parity assignments for nuclear energy levels are made or confirmed. Specific results for each isotope are summarized below.

$\text{Ce}^{143}$  (33.4 hour) decays to five excited states in  $\text{Pr}^{143}$ . The maximum energies, in kev, relative intensities, and log ft values of the transitions are: 1405 (37%; 7.7), 1125 (40%; 7.3), 740 (5%; 7.7), 495 (12%; 6.6), and 220 (6%; 5.8).

$\text{Pr}^{143}$  (14 day) is found to decay directly to the ground state of  $\text{Nd}^{143}$ , as previously reported. The transition has a maximum energy of 930 kev, with a log ft of 7.6.

$\text{Eu}^{152}$  (13 year) decays to five excited states of  $\text{Gd}^{152}$ . The energies, in kev, relative intensities, and log ft values of the transitions are: 1459 (21%; 11.6; unique first forbidden shape), 1050 (6%; 11.7), 680 (51%; 10.1), 360 (13%; 9.7), and 220 (9%; 9.1). The high log ft values are attributed to K-forbiddenness, according to the collective model of nuclear structure. There is evidence that the  $\text{Eu}^{152}$  ground state is characterized by spin and parity 4-. No positron emission is observed.

$\text{Eu}^{154}$  (16 year) decays to six excited states in  $\text{Gd}^{154}$ . The transition energies, in kev, relative intensities, and log ft values are: 1840 (7%; 12.4), 1600 (3%; 12.1), 833 (20%; 10.9), 554 (30%; 9.9), 246 (28%; 8.9), and 150 (12%; 8.7). The probable K-forbiddenness of the transitions is discussed. There is evidence that the ground state of  $\text{Eu}^{154}$  has spin and parity 3-, confirming a recent spin measurement.

$\text{Tb}^{161}$  (7.15 day) decays to the ground state and two excited states of  $\text{Dy}^{161}$ . The energies, in kev, relative intensities, and log ft values of the transitions are: 531 (68%; 6.7), 447 (22%; 6.9), and 405 (10%; 7.2). Spin and parity assignments in the level scheme are discussed.

$\text{Ho}^{166}$  (26.9 hour) decays to the ground state and four excited states in  $\text{Er}^{166}$ . The transition energies, in kev, relative intensities, and log ft values are: 1839 (47%; 8.2), 1756 (37%; 8.3; unique first forbidden shape), 869 (9%; 7.8), 412 (5%; 7.2), and 230 (2%; 6.5).

$\text{Yb}^{175}$  (4.2 day) decays to the ground state and two excited states of  $\text{Lu}^{175}$ . Two of the three beta transitions are resolved, with energies, in kev, and approximate log ft values of 471 (6.5-6.7) and 374 (6.6-6.9). The 374 kev transition has about 25% the intensity of the other. A transition at lower energy, required by the level scheme, was not observed because of the large number of internal conversion lines in that region.

$\text{Mn}^{52}$  (5.8 day) decays by K-capture and positron emission to  $\text{Cr}^{52}$ . Positron transitions to two excited states in  $\text{Cr}^{52}$  have energies, in kev, relative intensities, and log ft values of 574 (87%; 5.5) and 305 (13%; 5.3). The energy level at which the lower energy transition terminates is tentatively identified with a level previously observed in proton scattering.

$\text{Co}^{57}$  (267 day) decays by K-capture to  $\text{Fe}^{57}$ . Very weak positron activity in the source is thought to be due to contamination. K/L values measured for two of the gamma transitions are in agreement with previous reports.

$\text{Co}^{58}$  (71 day) has a positron spectrum with one component, whose maximum energy is 485 kev, with a log ft value of 6.6. This result confirms previous reports on this isotope. Microfilm \$2.05; Xerox \$7.20. 153 pages.

# BETA AND GAMMA DECAYS FROM SOME ODD-ODD, SELF-CONJUGATE NUCLEI AND THEIR ISOBARIC NEIGHBORS

(L. C. Card No. Mic 58-3647)

James Edward Cline, Ph.D.  
University of Michigan, 1958

The present experiment was undertaken to study the properties of the  $N = Z, A = 4n + 2$  ( $n = \text{integer}$ ) nuclei and their adjacent isobaric neighbors by time and energy analyses of the positrons and gamma-rays emitted from the unstable nuclei in these groups. The specific groups studied were those with  $A = 38$ ,  $A = 30$  and  $A = 26$ . The objectives of this research were: (1) To obtain information about the level schemes and spacings of the  $N = Z$  nuclei, especially with regard to the relative spacings of the two lowest-lying levels in these nuclei; (2) to obtain more accurate ft values than presently exist for the positron decays from the ( $N = Z$ ) nuclei; and (3) to obtain the lifetime of the heretofore-never-observed ( $N = Z - 2$ ) member of these triads.

The studied nuclei were produced by  $(\gamma, n)$  and  $(\gamma, n^d p)$  photonuclear reactions using the 20 cps, pulsed, 85 mev bremsstrahlung beam of the University of Michigan electron synchrotron. Development of adequate shielding allowed the technique of scanning the targets (by scintillation detectors) in the position in which they were activated by the x-ray beam. A system was developed which would control the bombardment time and the time between bombardment periods, allowing the compilation of decay curves which extended for several half-lives of the decay. Positron decay half-lives were measured by a coincidence technique which involved counting the annihilation radiation by two counters placed on opposite sides of a thick target.

$\log_{10} ft$  values for the positron decays of  $\text{K}^{38m}$ ,  $\text{K}^{38}$ ,  $\text{P}^{30}$  and  $\text{Al}^{26}$  were obtained; the values were  $(3.48 \pm 0.06)$ ,  $(4.89 \pm 0.07)$ ,  $(4.81 \pm 0.07)$  and  $(3.38 \pm 0.07)$  respectively. A series of three energy determinations, consisting of energy measurements of the positron and gamma transitions in the decays of  $\text{K}^{38}$  and  $\text{K}^{38m}$ , yielded the result that the ( $T = 0, J = 3^+$ ) is the ground state of  $\text{K}^{38}$  and that the ( $T = 1, J = 0^+$ ) level lies  $(210 \pm 190)$  kev above.

Branching in the positron decay of  $\text{Ca}^{38}$  to a level at  $(3.5 \pm 0.14)$  mev in  $\text{K}^{38}$  has led to a half-life determination for the decay of  $\text{Ca}^{38}$  of  $(0.66 \pm 0.05)$  seconds, and a tentative identification of the level in  $\text{K}^{38}$  as a ( $T = 0, J = 1^+$ ) level. A search for a similar branching of the  $\text{S}^{30}$  decay, specifically to a 690 kev level in  $\text{P}^{30}$  (previously identified in two separate experiments as having  $J = 0$  (implying  $T = 1$ ) and  $T = 0$  (implying  $J = 1^+$ )), with a negative result has led to the belief that the state has both  $T = 0$  and  $J = 0$  (in violation of the usual coupling rules in the  $N = Z, A = 4n + 2$  nuclei); branching would not be expected to occur in any appreciable amount to such a level.

The positron decays from the mirror nuclei  $\text{Ca}^{39}$ ,  $\text{S}^{31}$  and  $\text{Si}^{27}$  were also studied and these decays yielded  $\log_{10} ft$  values of  $(3.65 \pm 0.06)$ ,  $(3.79 \pm 0.07)$ ,  $(3.41 \pm 0.07)$  respectively. Such values are consistent with the fact that the decays should be superallowed transitions.

Of interest also were the relative yields from the  $(\gamma, n^d p)$  and  $(\gamma, n)$  reactions. These were measured to be  $0.40 \pm 0.05$ ,  $0.43 \pm 0.05$  and  $0.16 \pm 0.04$  for the bombardment of  $\text{Ca}^{40}$ ,  $\text{S}^{32}$  and  $\text{Si}^{28}$  respectively by 85 mev bremsstrahlung. The ratio was  $0.13 \pm 0.03$  and  $0.11 \pm 0.03$  for bombardment of  $\text{Si}^{28}$  by 60 mev and 40 mev bremsstrahlung

respectively. Interpretations are made of these ratios with respect to themselves and to data of other investigators.  
Microfilm \$2.00; Xerox \$7.00. 149 pages.

# A STUDY OF LOW ENERGY TRANSFER INTERACTIONS BY FAST MU-MESONS

(L. C. Card No. Mic 58-3783)

James Keith de Pagter, Ph.D.  
Washington University, 1958

Chairman: Robert D. Sard

This study was a continuation of a series of experiments<sup>(1,2)</sup> on neutron production by fast mu-mesons in the Cosmic Radiation, using refinements of the same techniques. The experimental approach followed was to have the lead target surrounded by paraffin and BF<sub>3</sub> neutron counters which formed a detector for neutrons from the lead of 9.3% efficiency. A magnet cloud chamber was placed above the target. It served to measure the incident particle's momentum and to indicate whether it was accompanied by other particles or not. Coincidences were observed between penetration of the cloud-chamber-target material array and detection of one or more neutrons.

The three processes which could give rise to neutrons associated with a penetrating particle are: a direct nuclear interaction by a fast mu-meson, and indirect photo-nuclear interaction by a photon in a knock-on shower caused by a mu-meson, and lastly a nuclear interaction by a proton (protons form 0.5% of the incident sea level radiation). Separation of these three effects was achieved by dividing the 6 inch thick target material into 1/2 inch slabs with hodoscoped Geiger tubes in between, and by requiring the particle to penetrate 9 inches of iron mounted below the lead and neutron detector array. This effectively eliminated the proton contribution to events in which only a single file of Geiger tubes were discharged in the hodoscope. Proton interactions are known to be quite catastrophic, and interactions violent enough to have secondary products penetrate 9 inches of iron would almost certainly be seen in the hodoscope. Detection of the larger knock-on showers by the hodoscope made it possible to distinguish between the direct and indirect mu-meson interactions.

The results are compared to what would be expected if the coupling to the nucleus is through the mu-meson's electro-magnetic field. This involves the comparison of the results with experimentally known photo-nuclear neutron yields by means of the well-known Weizsacker approximation. The agreement is well within the uncertainties of the approximations used, both in absolute magnitude and also in the distribution in momentum of the interacting particles.

Good agreement was found as well with the results of the previous experiments<sup>(1,2)</sup>, which did not effect the separation of the direct and knock-on effects. The product of the mu-meson nuclear interaction cross section and the mean number of neutrons emitted per interaction ( $\sigma \bar{m}$ ) was measured to be  $9.1 (\pm 1.8) \times 10^{-29}$  cm<sup>2</sup>/nucleon and the effective  $\sigma \bar{m}$  for the shower effect is  $11.4 (\pm 2) \times 10^{-29}$  cm<sup>2</sup>/nucleon for mu-mesons at sea level.

It is concluded that the production of neutrons in low

energy (under 500 Mev) interactions by mu-mesons can be adequately understood in terms of electro-magnetic processes. Microfilm \$2.00; Xerox \$4.20. 79 pages.

1. H. C. Wilkins, Ph.D. Thesis, Washington University, 1952.

2. B. F. Stearns, Ph.D. Thesis, Washington University, 1957.

# SMALL DEVIATIONS FROM THEORY OBSERVED IN BETA SPECTRA

(L. C. Card No. Mic 58-2914)

Joseph Hants Hamilton, Jr., Ph.D.  
Indiana University, 1958

Investigations were made with a large, 180° shaped magnetic field spectrometer to determine whether the deviations from the predictions of the present theory reported in the beta spectra of In<sup>114</sup>, P<sup>32</sup>, and Y<sup>90</sup> are real or instrumental. The experimental procedures were carefully studied and controlled. Thin, uniform sources, < 10 μg/cm<sup>2</sup>, were prepared by thermal evaporation in vacuum on backings ranging from 6 to 180 μg/cm<sup>2</sup>. End window G-M and proportional counters with loop and bead anodes were used at various gas pressures. Measurements made with different slit and baffle arrangements checked scattering and the transmission and focusing properties of different portions of the magnetic field. The spectra of Pr<sup>143</sup>, Pm<sup>147</sup>, and Na<sup>22</sup> were carefully measured and critically compared to the theory. The spectra of the once forbidden, non-unique transitions Pr<sup>143</sup> and Pm<sup>147</sup> exhibit nonstatistical and statistical shapes, respectively. The Pr<sup>143</sup> experimental shape factor was also measured with a 4π scintillation spectrometer and the results agreed very well with the magnetic spectrometer data. This comparison furnished an overall check of instrumental distortion and the agreement indicated that the two spectrometers are measuring "true" spectral shapes since they are so different in construction. The experimental shape factor of Pr<sup>143</sup> was fitted with the usual theoretical, once forbidden, non-unique shape factor for ST interactions, but a good fit with VA is extremely likely. An ST shape factor for Pr<sup>143</sup> can be written approximately as (1 + b/W). The experimental shape factor for Pr<sup>143</sup> was fitted with (1 + b/W) with 0.1 < b < 0.35. The Pm<sup>147</sup> spectrum exhibits a statistical shape down to 15 kev, where backing thickness effects begin. The Pm<sup>147</sup> spectrum could be consistently fitted, however, with a shape factor (1 + b/W) with b ≤ 0.3 in agreement with the theoretical equation suggested by Kotani and Ross. The allowed Na<sup>22</sup> positron spectrum exhibits a non-allowed shape. Its Fermi plot was linearized by the shape factor (1 + b/W) with 0.25 ≤ b ≤ 0.35. An electron distribution was observed accompanying the Na<sup>22</sup> decay. The measured ratio of the electron intensity for energies > 2 kev to positron intensity is 2.2(+ 0.9, - 1.1) × 10<sup>-3</sup>. The measurements roughly agree with the general theory of Levinger and others for "shake off" electrons. The approximations in the general theory, however, are poor for Na<sup>22</sup> so that a worthy comparison of theory and experiment requires more exact calculations. The Fermi plots of Na<sup>22</sup>, In<sup>114</sup>, P<sup>32</sup>, and Y<sup>90</sup>, which decay by pure Gamow-Teller radiations, are

linearized by the empirical shape factor  $(1 + b/W)$  with  $0.20 \leq b \leq 0.35$ . This factor in the electron spectra of  $\text{In}^{114}$ ,  $\text{P}^{32}$ , and  $\text{Y}^{90}$  has been interpreted by Johnson as a Fierz correction. But the  $b/W$  term in the Fierz factor must change sign for positrons and electrons and a sign change was not observed in the  $\text{Na}^{22}$  shape factor. This excludes a Fierz interference interpretation for the above four spectra. The data were corrected for well known theoretical refinements such as finite de Broglie wave length (tables of Rose et al.) and outer screening. The finite de Broglie wave length correction, although in the right direction, is much too small to explain the shapes. No instrumental distortions were found to explain the observed shape factors. Better theoretical calculations of small corrections are needed before any reliable explanation of the empirical correction observed in the above four spectra can be given.

Microfilm \$2.00; Xerox \$6.00. 124 pages.

#### CLOUD CHAMBER DROP COUNTING STATISTICS AND IONIZATION

(L. C. Card No. Mic 58-3787)

Robert Irving Louttit, Ph.D.  
Washington University, 1958

Chairman: Robert D. Sard

This study was an outgrowth of an investigation into the properties of heavy unstable particles. It was based on the desire to determine the masses of charged particles stopping in the plates of a multiple plate cloud chamber, and to measure the velocities of particles which decay in flight, as an aid in the analysis of such decays. Use was made of the fact that the ratio of range to mass of a particle, and the ionization of the particle are both functions of velocity. A cloud chamber in which conditions were suitable for the resolution of drops on individual ions was located immediately above a second chamber containing eleven brass plates. They were triggered by a conventional Geiger-tube penetrating shower detector which favored nuclear interactions occurring in the lead interaction layer close to the top of the drop count chamber.

This thesis is particularly concerned with a determination of the relationship between drop count distribution and ionization. For this purpose, the photographs of events in the cloud chambers were scanned for tracks of particles stopping in the plates of the multiplate chamber, which could be traced back through the drop count chamber. The drops were counted in two millimeter cells along the track and the distribution of drops counts obtained. A large number of the particles could be identified by visual estimation of their increase in ionization in the multiplate chamber with decreasing residual range. This made it possible to calculate their relative ionizations in the drop count chamber. The tracks were placed in three groups according to their expected relative ionization in the drop count chamber. Each track in the first group was normalized to minimum ionization, in the second to  $1.6 \times$  minimum, and in the third to  $2.0 \times$  minimum. Within the groups, the drop distributions for individual tracks were added together to form a single "parent" distribution for each value of relative ionization. These were compared

with a rough theory of drop distribution based on Landau's theory of energy loss by ionization.<sup>(1)</sup>

Agreement was found in general shape, although the experimental distribution was wider, and its peak occurred at a lower value. However, the conditions for validity of Landau's theory were not fully met in this experiment, so these results are not necessarily in disagreement with it.

Several percentiles, and the mean value of drops per cell were calculated for each track and compared in an attempt to select the best "estimator" of ionization. The mean value was found to have the smallest fractional sampling error, and was used in the calibration of drop count versus ionization, as well as in subsequent mass calculations. The error in mean drop count was about 17% near minimum ionization, and about 8% for twice minimum, resulting in errors on relative ionization of 25% and 15% respectively, due to the slope of the calibration curve.

The calibration was used to test the drop counting vs. range method for efficiency in mass determination. The errors which must be assigned to masses calculated in this way are large ( $\sim 50\%$ ), and it was concluded that the method is not applicable for precise mass measurements on individual particles under conditions similar to those in this experiment. It does, however, permit a statistical sorting of a mixture of pions and protons. Our sample of 121 particles constituted such a mixture, and a sorting was performed. This yielded a pion to proton ratio of about 1.2 to 1 for a kinetic energy interval of 66 to 245 Mev for the pions and 140 to 430 Mev for the protons.

Suggestions are made for improvement of precision and for further use of the method.

Microfilm \$2.00; Xerox \$6.00. 125 pages.

1. L. Landau, J. Physics, USSR, VIII, 201, 1944.

#### THE MEASUREMENT OF THE ELECTRON ENERGY REQUIRED TO PRODUCE AN ION PAIR IN VARIOUS GASES

(L. C. Card No. Mic 58-3048)

Ira Thomas Myers, Ph.D.  
State College of Washington, 1958

Measurements were made of the energy to produce an ion pair in air. The results were: using Cobalt-60 gamma rays,  $33.3 \pm 0.8$  ev/ip; using tritium beta particles,  $35.2 \pm 1.8$  ev/ip. The increase of  $W(\text{Air})$  with increasing energy predicted by Wang and Bethe was not found.

Tables of previous work by other authors are included. A summary is given including a "best" value of the energy to produce an ion pair in 43 different gases, for electrons, alpha particles, and protons.

Microfilm \$2.00; Xerox \$5.00. 97 pages.

# HIGH RESOLUTION NEUTRON SPECTROSCOPY IN THE KILOVOLT REGION

(L. C. Card No. Mic 58-2744)

Paul Frothingham Nichols, Ph.D.  
Duke University, 1958

Supervisor: Henry W. Newson

This dissertation reports the development of a new high resolution neutron spectrometer\* for the measurements of total cross sections in the kilovolt region. Protons from a Van de Graaff accelerator impinge upon a thin lithium target and produce neutrons from the  $\text{Li}(p,n)\text{Be}$  reaction. The neutrons enter the instrument at  $160^\circ$  through an aperture defined by two large polyethylene cones and are detected by two separate banks of boron trifluoride counters. The counter banks cover  $300^\circ$  of the conical aperture in order to improve the counting rate.

The factors contributing to the final energy spread are the finite thickness of the lithium target, the finite size of the proton beam area, the incident proton spread, the Doppler effect in the lithium target, and the finite opening between the cones. The last effect, which is equal to  $(dE_N/d\theta) \Delta \theta$ , increases much more rapidly with neutron energy than the target and Doppler effects, so the angular opening  $\Delta \theta$  was made mechanically adjustable. The opening is increased for low energies at which the yield is poor, and decreased for higher energies at which the spread caused by the angular opening would otherwise predominate. The proton spread has been reduced to such an extent that it is effectively negligible. The resolution now seems to be limited by roughness of the thin lithium target. A calculation has been made of the anticipated resolving power for a uniform target.

The yield curve has been measured from 0 kev to 200 kev, and has a maximum at 100 kev. An estimate of the scattered background has been made by measuring wide resonances by the transmission method in fluorine, iron, aluminum, and calcium.

The total cross section for  $\text{Bi}^{209}$  was measured from 10 kev to 135 kev, and prominent resonances were found at 12, 15, 33, 45, 68, 80, 84, 94, 101, 112, 117, and 134 kev. A resolution correction was applied to the peak height data for the first four resonances. The measured cross sections corrected in this manner reach the theoretical values. The average level spacing is about 16 kev per J value. An estimate has been made of the width,  $\Gamma_n$ , which is reasonably accurate for the resonances below 70 kev. The widths for those resonances fall between 100 and 900 ev.

Microfilm \$2.00; Xerox \$3.80. 66 pages.

# STUDIES OF THE ORBITAL ELECTRON CAPTURE DECAYS OF $\text{Ce}^{139}$ AND $\text{Os}^{185}$

(L. C. Card No. Mic 58-2930)

Charles Herbert Pruett, Ph.D.  
Indiana University, 1958

The studies of  $\text{Ce}^{139}$  and  $\text{Os}^{185}$  were undertaken for the purpose of applying the combined methods of magnetic beta-ray spectroscopy and scintillation spectroscopy to the problem of obtaining information about nuclear energy levels from orbital electron capture decays. In many cases of positron or negatron decay most of the properties of the energy levels can be determined by the methods of magnetic beta-ray spectroscopy alone; however, the absence of knowledge about intensities and end points of beta-groups in capture decays requires more complicated methods in their analysis.

The equipment used in these investigations consisted of a  $180^\circ$  shaped field spectrometer with a mean radius of 11 cm, a  $180^\circ$  permanent magnet beta-ray spectrograph with a maximum energy limit of 360 kev, a single crystal scintillation spectrometer, and scintillation coincidence spectrometers.

The decay of  $\text{Ce}^{139}$  to  $\text{La}^{139}$  was studied in order to determine the true mode of the decay and to try to relate the measured parameters of the nuclear levels excited to those predicted by theory.

After very careful chemistry was performed to remove all sources of contamination from the  $\text{Ce}^{139}$  being studied, magnetic and scintillation spectrometer measurements showed that only a single level at 166.5 kev above the ground state of  $\text{La}^{139}$  was excited in the decay. Measurements of the 166.5 kev gamma-ray, its conversion electrons, the X-rays, and the auger electrons emitted in the decay permitted determination of the K internal conversion coefficient for the gamma-ray. The multipolarity of the gamma-ray transition was determined to be M-1 from the internal conversion coefficient and the K/L+M ratio. The assignment of d 5/2 for the excited state of  $\text{La}^{139}$  and the assignment of d 3/2 for the ground state of  $\text{Ce}^{139}$  which were based on the experimental results were in agreement with the assignments predicted by the shell model of the nucleus.

In the investigation of the decay of  $\text{Os}^{185}$  to  $\text{Re}^{185}$  very careful chemistry was again performed to minimize any chance of contaminants being in the sources used for the measurements. Also the decays of the individual conversion lines were followed over a 217 day period to be sure that all measured lines belonged to the 95 day activity of  $\text{Os}^{185}$ .

Two previously undiscovered gamma-rays at energies of 72.5 and 125 kev were found to occur in the decay. These gamma-rays together with others at energies of 162, 234, 649, and 880 kev which had been found by other investigators were fitted into a consistent decay scheme. The scheme was determined on the basis of energy and coincidence measurements; and level assignments were made on the basis of measured conversion coefficients, K/L conversion ratios, relative intensities, and lifetimes of the transitions. The system of levels excited in  $\text{Re}^{185}$  consists of a g 7/2 level 125 kev above the d 5/2 ground state; a spin 1/2, plus parity level at 647 kev; another spin 1/2, plus parity level at 808 kev; and a spin 3/2, plus parity level at

880 kev. From estimates of capture to the various levels, it was possible to make the assignment of  $p\ 1/2$  to the ground state of  $\text{Os}^{185}$ .

Microfilm \$2.00; Xerox \$4.80. 95 pages.

# INNER BETA SPECTRA OF $\text{Tm}^{171}$ , $\text{Ru}^{103}$ , $\text{Ag}^{111}$ , AND $\text{Rb}^{86}$

(L. C. Card No. Mic 58-2933)

Russell Lee Robinson, Ph.D.  
Indiana University, 1958

By use of a  $4\pi$  scintillation spectrometer, studies were made of the inner beta spectra of  $\text{Tm}^{171}$ ,  $\text{Ru}^{103}$ ,  $\text{Ag}^{111}$ , and  $\text{Rb}^{86}$ . Such electron spectral studies are of interest since information obtained may aid in constructing nuclear decay schemes and in making decisions about the correct beta decay theory.

The  $4\pi$  geometry of the spectrometer was obtained by sandwiching the source between two plastic phosphors. The inner beta spectra were observed separately by requiring beta-gamma coincidences. Gamma rays were detected with a NaI crystal which subtended  $\sim 21\%$  of the solid angle from the source.

The linearity of the spectrometer was checked by measuring six internal conversion electron lines with energies between 40 and 976 kev. Its capability to measure beta spectra was verified through the measurement of six known spectra.

A study was made of  $\text{Tm}^{171}$  in order to determine its decay scheme. An inner beta-ray group ( $E_0 = 30$  kev) was measured in coincidence with an  $\sim 67$ -kev gamma ray. Its intensity was estimated as  $2\%$  of the 97-kev ground state group. The assignments proposed for the ground state and first excited level of  $\text{Yb}^{171}$  are  $1/2^-$  and  $3/2^-$ .

The intense, inner beta-ray group of  $\text{Ru}^{103}$  was reported by Kondaiah<sup>1</sup> to have an anomalous deficiency of electrons at low energy. By means of the  $4\pi$  scintillation spectrometer the spectrum was re-examined in coincidence with the 495-kev gamma ray. The Fermi plot of this spectrum is linear from the endpoint energy,  $227 \pm 4$  kev, down to 37 kev. The beta spectrum in coincidence with the 610-kev gamma ray was also measured ( $E_0 = 119 \pm 4$  kev). By comparison of disintegration energies, it was deduced that both gamma rays terminate at the same level in  $\text{Rh}^{103}$ .

The relatively high  $\log ft$  value of 7.9 of the low energy, inner beta spectrum of  $\text{Ag}^{111}$  suggests that interference might result in a spectrum with a non-statistical shape. The Fermi plot of this spectrum, which was measured in coincidence with the 340-kev gamma ray, is not linear. The shape factor decreases by  $\sim 17\%$  in the energy range 80 to 600 kev. A satisfactory once forbidden, theoretical shape factor can be obtained by using only S and T interactions. Beta rays were also recorded in coincidence with the 247-kev gamma rays. Because of spectral distortion resulting from scattered 340-kev gamma rays, no conclusion can be made about the spectral shape. The endpoint energies (and intensities) of the groups in coincidence with the 340- and 247-kev gamma rays and the ground state group are  $690 \pm 13$  kev (6%),  $793 \pm 15$  kev (1%), and  $1044 \pm 20$  kev (93%), respectively. These energies indicate both gamma rays terminate at the ground state of  $\text{Cd}^{111}$ .

The inner beta spectrum of  $\text{Rb}^{86}$  might be expected to exhibit a non-statistical shape both because of its relatively high  $\log ft$  value of 7.9 and because of beta-gamma directional anisotropy between this group and its coincident gamma ray. The Fermi plot of the inner beta-ray group, measured in coincidence with the 1.08-Mev gamma ray, is linear for energies greater than 220 kev ( $E_0 = 717 \pm 14$  kev). At 100 kev the deviation away from linearity amounts to a 9.3% increase in the counting rate. It seems unlikely that the deviation is due to an impurity, a second inner group in  $\text{Rb}^{86}$ , a thick source ( $\sim 1\ \mu\text{g}/\text{cm}^2$ ) or backing ( $\sim 10\ \mu\text{g}/\text{cm}^2$  zapon), or an instrumental effect.

Microfilm \$2.00; Xerox \$6.00. 123 pages.

1. E. Kondaiah, Phys. Rev. 79, 891 (1950).

# A STUDY OF THE NUCLEAR SELF-CONSISTENT FIELD PROBLEM AND THE USE OF SLATER TYPE NUCLEAR WAVE FUNCTIONS

(L. C. Card No. Mic 58-2797)

Nyayapathi Venkata Vykuntha Jagannadha Swamy, Ph.D.  
The Florida State University, 1958

The shell model wave functions have played an important role in nuclear physics. Harmonic oscillator wave functions, square well wave functions and plane wave functions have been used till now in calculations of nuclear binding energies, Coulomb energies, charge and nucleon distributions, quadrupole moments, etc. Numerous recent studies have shown that the nuclear boundary is diffuse. Green has obtained an approximate solution for a diffuse boundary potential well. The nature of the approximation necessitated expressing the wave function as a two-zone function which has a smooth joining across the boundary. The outer zone wave functions, which are Bessel functions of non-integral order of arguments which are exponential functions, are rather inconvenient functions and it is difficult to use these in many calculations.

The diffuse boundary potential wave functions for some light nuclei have been approximated in nodeless cases by Slater type single particle functions

$$Y_{e,m}(\theta, \phi) C_e r^{n_e} e^{-k_e r}.$$

The densities calculated therefrom are in reasonable agreement with those resulting from the two-zone functions. The use of these in a many particle Slater determinant wave function for the nucleus has been demonstrated by calculating Coulomb exchange energies of  ${}^3\text{Li}^7$ ,  ${}^4\text{Be}^9$ ,  ${}^7\text{N}^{14}$ , and  ${}^8\text{O}^{16}$ . It is observed that the earlier calculation of Bethe using antisymmetrized plane waves overestimates the exchange energy in light nuclei, a fact also noticed in mass surface studies by Geen.

The use of the above functions as trial functions in a variational approach to solving the Schrodinger equation for simple analytical potentials has also been studied, and a method has been developed for searching the right neighborhood for the values of  $n$  and  $k$  that minimize the expectation of the Hamiltonian.

A study of the nuclear self-consistent field problem has been made. The nucleus studied was  $\text{O}^{16}$ . A phenomenological density resulting from a diffuse boundary potential

was taken as the starting point. Using a Yukawa type two-body attraction an average nuclear potential has been calculated. The Schrodinger equation for this potential was then solved approximately by a variational method and a new density obtained. Proceeding in this way up to three cycles, it has been observed that the nucleus collapses in each cycle and also that the binding energy of the nucleus is very small. Introducing a repulsive core, a two body interaction was chosen such that it turns repulsive at a distance of about 0.4 fermis and rapidly rises to infinity at the origin. The parameters for the attractive part are

those given by Gammel et al., fitting two body experimental data. It has been observed that stability and convergence in successive cycles as well as adequate binding can be obtained provided different repulsive terms are used in the two body interaction for the s and p angular momentum states. In other words, the potential felt by a particle depends on its momentum, which confirms the idea of non-local potentials. An attempt has been made to obtain the effective mass which would reduce the velocity dependent potential to a static one and to infer the degree of non-locality. Microfilm \$2.00; Xerox \$5.40. 106 pages.

## POLITICAL SCIENCE

### POLITICAL SCIENCE, GENERAL

#### THE POLITICAL PROCESS AND THE NATIONALIZATION OF THE RETAIL TRADE IN THE PHILIPPINES

(L. C. Card No. Mic 58-2897)

Remigio E. Agpalo, Ph.D.  
Indiana University, 1958

This study describes the politics of the nationalization of the retail trade in the Philippines, which adversely affected Chinese inhabitants in the Philippines mostly. "Nationalization," however, is not used with its socialist connotation of state control and ownership but rather of citizen control and ownership.

A framework of analysis was adopted in the study in order that significant aspects of the political process may not be overlooked or missed. This framework includes, among other points, the group basis of politics, the unity and continuity of the governmental process, the importance of historical and ecological factors in the study of the political process, and the significant role of ideology, strategy, and tactics in the political struggle.

The study reveals that the attempt to nationalize the retail trade since 1903 has been persistent and consistent. It also shows that the politics of the nationalization of the retail trade is a long and complicated process. With an historical background and ecological factors going back to several years in the past, the process involved numerous governmental and private groups and individuals that became enmeshed in conflicting legal, political, social, and moral principles as they struggled in the governmental and non-governmental areas of the political arena.

The study, however, is focused on the development of a public policy--the nationalization of the retail trade--as it enters the legislative process, the administrative process, the agitational process, and the judicial process.

The legislative culmination of the politics of the nationalization of the retail trade is Republic Act No. 1180, popularly known as the Retail Trade Nationalization Act, which was passed by Congress on May 20, 1954 and approved by the President on June 19, 1954. It was challenged by the Chinese to have violated the due process and equal protection clause of the Philippine Constitution on July 26, 1954, but the Supreme Court of the Philippines declared the Act constitutional on May 31, 1957.

The politics of the retail trade produced two important political problems, which involve internationalism and democracy. By nationalizing the retail trade, the Philippines opened herself to retaliation from China and other affected countries, undermined the idea of international cooperation underlying the United Nations Charter, and laid herself open to criticism as being oppressive and unjust to aliens in the Philippines, particularly the Chinese. But, if the Philippines did not nationalize the retail trade, then Philippine economy and security might be endangered.

Thus, the politics of the nationalization of the retail trade reveals the difficult and terrible task of statesmanship. It is difficult because a political problem, like the retail trade nationalization problem, is amenable to many answers, and also because the choice of answers is quite often between Scylla and Charybdis. And it is terrible because statesmanship requires action or decision on the part of the statesman, but whenever he acts or decides he cannot escape committing some form of injustice or selfishness. Statesmanship, therefore, does not involve the question of how to solve a political problem without committing injustice and selfishness, but rather of how to solve it with the least amount of injustice and selfishness.

Microfilm \$4.80; Xerox \$16.00. 375 pages.

#### THE OFFICE OF THE GOVERNOR IN FLORIDA

(L. C. Card No. Mic 58-3662)

Juanita Marguerite Gibson, Ph.D.  
University of Michigan, 1958

The purpose of this study is to increase the knowledge and understanding of the office of the governor in Florida. A brief historical approach is used to show the development of the office. The principal frame of reference, however, is contemporary; the main objective is to present an accurate and objective picture of the present day powers, duties, and role of Florida's governor. The office of the governor is also compared with that of the President of the United States. Since the office of the President contains the elements characteristic of a strong executive, the comparison here between the Florida governor and the presidency is made to determine how closely executive power in Florida resembles executive power at the national level. Keeping in mind that the executive at the state level and at the national level must each operate within his own particular political framework and administrative organization, the motivating thesis has been to make Florida's governor, like the President, a chief executive in action as well as in title.

To provide general background information, the first portion of the study is devoted to the evolution of the Florida governorship and of the presidency. In addition, one chapter is devoted solely to the ecology of Florida government including the population and economy of Florida, the cabinet system, the "little cabinet," the legislature, the court system, and party politics. Another chapter is devoted to the legal and extra-legal characteristics of the office of the chief executive. It includes the legal and extra-legal qualifications for office, method of selection, term of office, reeligibility, succession, and compensation and emoluments of the governor and the President.

The major portion of the study is devoted to the chief

executive in his four major roles--the chief executive as chief of state and chief magistrate; the chief executive as chief administrator; the chief executive and external relations; and, the chief executive as chief legislator and party leader.

Several general conclusions can be drawn from the study. The office of the governor of Florida, in comparison with the office of the President of the United States, is not a strong one. The essence of executive power is the same at both levels, but the political and administrative settings within which the two executives must operate are quite different. Moreover, the formal "tools of management" which the President has at his command far exceed those available to the governor. Yet, despite the lack of many formal "tools" the governor, through his informal authority and extra-legal powers, can exercise considerable influence over most of the activities of state government.

To make the governor a politically responsible chief executive in fact as well as in name will require major changes in the framework of the executive branch and in the political party situation. Addition of important administrative "tools" will also be necessary. However, before any real progress can be achieved, general citizen apathy and distrust of enhancing gubernatorial power will have to be overcome; vested interests desirous of maintaining the *status quo* will have to be reckoned with; a well-defined two party system will have to be developed; and, finally, the electorate will have to be persuaded that a strong chief executive will serve its best interests.

Although it lacks the legal powers and "tools" necessary in a strong executive office, substantial strengthening of the office of the governor in Florida should not take place until the governor is subject to a greater democratic responsibility than he is today.

Microfilm \$3.40; Xerox \$11.60. 261 pages.

#### THE GOVERNMENT OF FINLAND SINCE 1947

(L. C. Card No. Mic 58-2810)

Raymond Henry Kaaret, Ph.D.  
The American University, 1958

The strategic position of Finland between the powers of the East and West has created for that small nation tensions and problems unknown to other Western democracies. Accordingly, Finland's political institutions have tended to develop characteristics somewhat different from those of her sister democracies. Furthermore, the Finns have undertaken to combine certain features of a "presidential" form of government with their basically "parliamentary" or "cabinet" form of government. Recent comprehensive studies of a political nature of the Finnish constitutional system, particularly in the universal languages, are scarcely available.

It was the purpose of this study to (1) to present a description and critical analysis of the structure and operation of the present-day governmental system of the Republic of Finland, with primary reference to the relationships among the President, Prime Minister, Cabinet, and Parliament; (2) to identify and interpret some of the important dynamic features of the central governmental sys-

tem; and (3) to draw attention to certain unique features of the Finnish constitutional system that warrant further closer study by students of comparative government and administration.

After briefly presenting the historical background of the Finnish people and their political history, the present-day political institutions of Finland were described and analyzed so as to show what were the significant inter-relationships among the component parts of the constitutional system. The use of official and secondary source material was supplemented by personal observations and interviews with key representatives of the Finnish government and other informed persons, both in Washington and in Finland.

The study revealed that Finland's political system is based upon a written constitution that has roots tracing back to the several centuries of union with Sweden. Although under the domination of the Russian Empire for another century, Russian influence on the Finnish constitutional system was negligible. The sovereign power of the people is exercised through their popularly-elected representatives in the unicameral parliament. A cabinet system of government is used to carry on the administration of the affairs of state. An independent judiciary exercises judicial power. The most interesting and unusual feature of the manner of distribution of authority in the state is found in the presidency. Finland has superimposed a strong president upon a basically parliamentary form of government. He has been granted supreme executive powers and shares legislative authority with the parliament. He appoints and dismisses ministers and can dissolve the parliament and order new elections. The remarkable fact is that these powers are real as well as nominal, a fact which creates unique relationships between the executive and the parliament. Other observations showed that national administration is characterized by extensive decentralization and the principle of local self-government is observed in high degree. Citizen participation in the proceedings of the lower courts is found to an unusual degree.

Major conclusions from this study tended to indicate the following: (1) the distinctive constitutional system that has been developed by the Finnish people is largely traceable to the peculiar circumstances of their geographical situation, physical environment, economic circumstances, and cultural and ethnological background; (2) there has been incorporated into the Finnish constitutional system a dualism with respect to the distribution of legislative and executive authority among the President, the Cabinet, and the Diet, which has made the Cabinet responsible to the President as well as the Diet, but this dualism has not vitiated the principle of the "parliamentary executive," rather it has created a valuable system of checks and balances; and (3) the democratic basis of the Finnish political system is strengthened by the great degree of citizen participation in the work of the lower courts, and the strong adherence to the principles of administrative de-centralization and local self-government.

Microfilm \$4.85; Xerox \$16.20. 380 pages.

# CONSTITUTIONAL ASPECTS OF THE EXTRA-CONTINENTAL JURISDICTION OF THE UNITED STATES

(L. C. Card No. Mic 58-3699)

Harold James Leu, Ph.D.  
University of Michigan, 1958

The Constitution of the United States contains little reference to the exercise of jurisdiction by the Federal government outside the limits of the member States of the Union. Despite the basic principle that the governmental authority of the national government is limited in our system to the exercise of those powers provided specifically or by implication in that document, the exercise of such extra-continental powers is becoming increasingly important.

The purpose of this study is to determine the basis for the exercise of the national authority beyond the State and the role of the courts in its delimitation and development. The vagueness of the constitutional provisions might be expected to open the door to the exercise of extensive judicial power in the guise of interpretation. The extent to which this power of policy determination has been used by the courts and the factors which have tended to minimize such action are also objects of the study.

An introductory chapter pays some attention to the considerations which led to the neglect of the subject of extra-Union jurisdiction by the framers of the Constitution and briefly considers the development of the companion theory that the Federal government is vested with an inherent power to deal with foreign relations. The plan of the study involves consideration of areas in which the United States has differing degrees of sovereign control. Those areas, outside the States, under the full ownership and control of the United States are first considered. Attention is then turned to those areas where the jurisdiction of the United States is based on something less than full ownership. The guano islands, leased bases, Canal Zone, and territories under trusteeship and military occupation fall into this category. Next examined is the jurisdictional basis in those areas, such as the high seas and the marginal waters, which are not fully within the domination of any state under the rules of international law. Finally the recent regime of the continental shelf is examined.

Notice is taken throughout of the decisions of the Supreme Court in relation to the exercise of extra-continental jurisdiction by the United States in defining the constitutional limits of the governmental authority. Particular attention is given to the Insular Cases and the development of the theory of incorporation, the series of cases concerning the Atlantic bases leased from Great Britain, and the Tidelands Cases.

No attempt is made to deal with the question of personal jurisdiction within the sovereign territory of another state except insofar as it is covered in comment on the maritime jurisdiction. These exceptions to the exclusive jurisdiction of the territorial sovereign belong rather in the realm of international law and comity. As such they warrant separate extended treatment rather than brief consideration here.

The study indicates that the lack of an alternative agency to exercise obviously necessary control and the early development of the doctrine of the "political question" have resulted, in general, in a very liberal interpretation

of the powers of the national government outside the States. The courts have, however, made some attempt to utilize international law standards as limitations on the authority of the United States, particularly on the high seas. The Supreme Court has also, at times, developed new constitutional doctrines. Such new doctrines made their appearance in the Insular Cases and, less successfully, in the Tidelands Cases. Finally the courts have entered the field of policy making to some degree through selective statutory interpretation, especially in the absence of careful legislative action.

Microfilm \$6.00; Xerox \$20.00. 469 pages.

## POLITICAL SCIENCE, INTERNATIONAL LAW AND RELATIONS

### THE SOVIET IMAGE OF INDIA

(L. C. Card No. Mic 58-2805)

Vijay Sen Budhraj, Ph.D.  
The American University, 1958

This study is an attempt to present the picture the Soviet leaders had of India in the early 'twenties as well as after 1947. In examining and evaluating this picture, it was found essential to state the evolution of the colonial question in the Marxist-Leninist ideology, and also to analyze the role and the significance of this ideology in the Soviet image of India. The strategies of the Communist Party of India after World War II have also been studied against the background of this picture.

Karl Marx came to support all those nations in which bourgeois democratic development was relatively advanced. In his overall concept of social and political consciousness of the peoples of the world and in the context of their march towards communism through a series of dialectical phases, he viewed Indian society "semi-barbarian" and "semi-civilized." He considered colonialism a "historic necessity" and held that by introducing capitalism in India, Britain was laying there the material foundations of a capitalist society, a step forward from feudalism. He concluded that the victory of the proletariat in Britain would simultaneously result in the emancipation of the colonies.

Lenin, more or less, supported this contention and devoted his attention and thought to the revolutionary movements in Europe for the overthrow of capitalism. Later he realized that the unrest in the colonies was an "inflammable material in world politics." No revolutionist could have disregarded this force. After the Bolshevik revolution communism and national movements in the colonies found themselves fighting against common enemies. Two forces fighting against a common adversary naturally become allies. The Soviet leaders shelved the embarrassing issues of religion and that of stages of social developments. They twisted their ideology in order to "use" these movements in the interest of their country. The Narkomindel pressed the national movements and the Comintern into its service. National-bourgeois movements became national-revolutionary movements in communist

terminology. This development of the colonial question in communist ideology has been traced in the first part of this study.

The second part takes up the postwar period when the Soviet leaders showed a lack of interest in Indian affairs. Soon thereafter, when India achieved independence, the Kremlin moved to the "left" strategy. Now Soviet Indologists began to consider India a "semi-colony" and its government an "agent" of British imperialism. The Indian National Congress was alleged to have betrayed the people. The Communist Party of India, the Cominform and the Soviet visitors to India echoed the same theme. A few years later Stalin indicated a change in Soviet foreign policy. The Nehru Government's adverse reaction to the announcement of American military aid for Pakistan brought an ideal situation for the Kremlin to take advantage of the antipathy of India to this move on the part of a big power. The Soviet press changed its tone and India was hailed "a big power" and a "peace factor in Asia."

Ideology was again sacrificed at the altar of expediency and *realpolitik*. These changes show that the Kremlin pays lip service to Marxism-Leninism. The relative strength of the USSR and its needs determine the relations between Soviet Russia and the rest of the world rather than the class consciousness of other peoples or the character of their governments.

To portray this image a study of several Soviet publications in English, Russian and Hindi has been undertaken. The organs of the Communist Party of India and the Cominform have also been examined. The first part has been developed from the writings of Karl Marx, Lenin, Trotsky and M. N. Roy, and from the protocols of Comintern congresses.

Microfilm \$2.60; Xerox \$9.00. 198 pages.

THE TURCO-PERSIAN BOUNDARY QUESTION:  
A CASE STUDY IN THE POLITICS OF  
BOUNDARY-MAKING IN THE  
NEAR AND MIDDLE EAST

(L. C. Card No. Mic 58-3226)

Maurice Harari, Ph.D.  
Columbia University, 1958

This is a reconstruction of the Turco-Persian boundary question in the context of European diplomatic developments, especially Anglo-Russian rivalry in the nineteenth and early twentieth centuries. The contemporary Near and Middle East is criss-crossed by a multitude of boundaries which appear on the surface to be similar, in nature and functions, to those separating the states of Europe. Yet, upon closer scrutiny, a certain unmistakable pattern of imprecision and fluidity in Near and Middle East boundaries emerges. Most of the countries of the area are plagued by boundary disputes. The present analysis of the unfolding Turco-Persian boundary question represents a case study in the politics of regional boundary-making.

An examination of the earlier treaties between the Ottoman and Persian states, starting with the Treaty of Zuhab of 1639, and of the geographical and tribal characteristics on their frontier zone is followed by an analysis of the origins of the Anglo-Russian intervention and medi-

ation in 1842 which eventually led to the signing of the Treaty of Erzurum in May 1847. A detailed study is made, based on primary material, of the Erzurum negotiations (1843-1844) and of the work of the Delimitation Commission (1848-1852). The substantive work of the latter and its mechanics are examined, showing that its function was finally downgraded to a mere exploratory survey of portions of the frontier zone. The eventual collation of the "Carte Identique" in 1869 by teams of British and Russian engineers is also described. The study then deals with the disturbances along the frontier zone through the end of the nineteenth century with special reference to the questions of Kotur and Pusht-i-Kuh. Throughout this entire period and until the beginning of World War I, the Turco-Persian boundary dispute lends itself admirably to an analysis of certain aspects of European-Oriental diplomacy and to the unusually interesting role played by the mediators. It is suggested that there were only two periods (1842-1853 and 1907-1914) during the seven decades of European intervention when a sufficient degree of unity existed between the two European powers directly involved. The mediators did not insist on an arbitration of the dispute before the Crimean War. While Persia could then be easily pressured, the same was not true for the Ottoman Empire which though sensitive to the concerted will of the European powers was not necessarily pliable to the will of England and Russia alone. In the last part of the dissertation, the structure and procedures of the 1913-1914 Boundary Delimitation Commission are examined and the developments after World War I are reviewed through the Turco-Persian agreement of 1932 and the Perso-Iraqi agreement of 1937.

In conclusion, it is suggested that the religio-political incompatibility of Shi'i Persia and Sunni Turkey militated against the delimitation of the precise territorial jurisdiction of the two states. A number of other factors are duly recognized, such as the difficulties inherent in the nomadic habits of the frontier tribes, their ambiguous loyalties, the tribal concept of territory and jurisdiction, and the rugged nature of the frontier terrain. But the special aspect stressed in accounting for the extraordinary prolongation of the negotiations is the clash in institutional concepts - European versus Oriental ideas and methods - accentuated by the Islamic character of the two principals. In support of this view, reference is made to the concepts of "boundary" and "sovereignty" in Islam and to the Westernizing trends in Turkey and Persia in the last half of the nineteenth century.

Microfilm \$3.55; Xerox \$12.00. 274 pages.

IRAQ IN TRANSITION

(L. C. Card No. Mic 58-2813)

Enver M. Koury, Ph.D.  
The American University, 1958

The purpose of the dissertation is to determine the main political, economic, cultural and sociological problems which must be faced and solved in bringing about the overall development of Iraq.

The roots of the present crisis in Iraq reach deep down into the past. Those weaknesses which appear on the

surface to be merely political or economic are in fact indicative of a long-standing cultural malady. The real causes of decadence in Iraq are not external and political but internal and social. This decadence is not due to the lack or the loss of material power but to the fact that the spiritual and cultural power within itself failed.

The general conception that culture is static is utterly false. Neither is it dynamic in the sense that it is rather easy to change at will. However, it is flexible enough to change when the situation is ripe and the people are ready to accept this change. On the other hand, culture is not a disease, which can be cured at will; its change is a struggle which must be fought over and over again.

The chief cause of cultural lag has been the slow acceptance by the people of what we term "value culture" as against "reality culture", for the two facets of culture are so interdependent as to make it rather hard to introduce changes in the one without making changes, at least later on, in the other. This situation was terribly aggravated because at the very time when the Iraqi was becoming a hopeless prey to increasing superstition, the West was discovering a new secret of endless knowledge and abundant life.

The Iraqi awakening in recent years, although feeble and unsystematic, has led to rapid changes. The rapid awakening is due to the internal factors such as the increase in education, better quality of leadership, spread of nationalism, and the general acceptance by the people for abundance of life, and the external factors where the Western impact is felt most. This awakening is a struggle for the Iraqi soul--whether through westernization, isolation, easternization, or more thorough Islamization--is far more than a temporary political struggle created by internal and external circumstances. The struggle is a struggle for the Iraqi soul itself; it has spiritual, political, economic and cultural implications and repercussions.

The cure of poverty, superstition, ignorance and ill-health requires a bootstrap operation. It requires economic, political and social development. To carry these developments Iraq should have responsible leadership, healthy nationalism, a spread of adequate education, and an adequate administrative system and public responsibility.

In conclusion, Iraq, slowly but surely, will modify its present political, educational, economic and cultural life. Whether this new system will follow the Western system is hard to tell, but one thing is certain, a new system will be of such a type as to fit the framework of the Iraqi society. Microfilm \$3.80; Xerox \$12.80. 294 pages.

#### THE SOVIET UNION AND THE MOVEMENT TO ESTABLISH AUTONOMY IN IRANIAN AZARBAIJAN

(L. C. Card No. Mic 58-2944)

Manoucher Vahdat, Ph.D.  
Indiana University, 1958

In 1941 the Soviet Union began its attempt to establish a Communist-led government in Iranian Azarbaijan, just as it had attempted in 1920-1921 to establish a "Persian Socialist Soviet Republic" in Guilan province. The main purpose of this study is to examine the problem of so-

called autonomous Azarbaijan and its use as a tool to further Soviet imperialism. The action of the United Nations Security Council which helped to preserve the integrity of Iran is also discussed.

Iran had been occupied by Soviet and British troops since 1941 and by United States troops since 1943. At the end of World War II the Iranian Government requested the Soviet Union, Great Britain, and the United States to withdraw their forces from Iranian territory in accordance with the terms of treaties and declarations to this effect. Four months after this request was made in September 1945, doubts arose in Tehran, London, and Washington as to whether the Red Army intended to leave Iran. The Soviet Union's reluctance to withdraw its army from Iran and its interferences in the internal affairs of the country created a problem which Iran finally laid before the United Nations Security Council.

Interferences by Soviet military and civil authorities in the internal affairs of Iran during 1945 and 1946 were not trivial interventions. From the time that Soviet armed forces entered the northern provinces in 1941, Soviet civil and military authorities had in one way or another committed flagrant breaches of explicit pledges and undertakings which the Soviet Government had accepted in the Treaty of Alliance of January 1942. These interferences not only endangered the territorial integrity, the political independence, and the fundamental sovereign rights of Iran, but threatened her with dismemberment.

In January 1946 the Iranian Government notified the United Nations Security Council that the refusal of the U.S.S.R. to withdraw troops which it had placed in Iran during the War, together with rebellion against the Government of Iran in the Soviet-occupied province of Azarbaijan, constituted interference in the internal affairs of Iran and had given rise to a situation which might "lead to international frictions."

After several months' debate in the Security Council, during which Great Britain and the United States brought pressure to bear against the Soviet Union both within and outside the Council, the Soviet Union admitted failure by withdrawing its forces from Iranian Azarbaijan.

It cannot be proved that the reference of this question to the Security Council and its discussion there caused the Soviet Union to terminate its occupation or to cease interference in the internal affairs of Iran. Nevertheless, during the airing of the Iranian charges, with extensive press coverage, and following the firmness of the Security Council in the face of Soviet attempted intimidation, the Soviet Union did withdraw its armed forces and the Communist-led rebellion in Azarbaijan collapsed. Consequently, it can be argued that the existence of the Security Council, its hearing of and discussion of the case, and its insistence on retaining the item on its agenda did contribute to a peaceful settlement. But it should be noted that what probably was most effective in saving Iran was not positive action by the United Nations but the fact that all three Big Powers took an active interest in Iran's affairs and that one of them, the United States, hinted at its willingness to use force on Iran's behalf.

Microfilm \$2.50; Xerox \$8.80. 191 pages.

## SOVIET STRATEGY IN IRAN 1941-1957

(L. C. Card No. Mic 58-2811)

Paul Elwood Weaver, Ph.D.  
The American University, 1958

Soviet Russia's wartime and postwar relations with Iran constitute a laboratory sample and pilot plant of Soviet foreign policy on the broader international scene. For example, the Soviet Union has employed a wide variety of means in Iran, ranging from the wartime occupation of the Province of Azerbaijan and the postwar subversive activity of the Tudeh (Communist) Party to Soviet blandishments of the Iranian people and flattery of the Shah when he visited Moscow in 1956. The Russians were squirming in an effort to outbid the Anglo-American Bloc and place Iran on Moscow's side in the bipolarization of the world. The fact that Iran is still outside the "orbit" of the Soviet Union proves the failure of Soviet strategy in Iran.

Soviet strategy, in this study, is concerned with the development and employment of Soviet political, economic and military forces in Iran as instruments of overall national policy. It represents a series of plans designed to produce a certain result. First, during 1941 to 1947, an anti-imperialist strategy was pursued which concerned World War II cooperation against the Nazis and other Fascists. The anti-imperialist strategy was carried on to 1947 because of the war and postwar cooperation among the Allies. This is often referred to as the "right" strategy. Second, an anti-capitalist, or "left," strategy which embodied a theme of hatred of capitalism and the native bourgeoisie appeared in 1947-1949. It can be identified with the beginning of the cold war. And third, beginning in 1949, an anti-Anglo-American strategy had Anglo-American "imperialism" as its main propaganda enemy. The fourth strategy, which appeared in 1953, represents a political appeasement and economic offensive by the Soviet Union. It carries on an anti-American theme but with a renewed emphasis on economic and cultural penetration.

This study does not reveal a "master plan" for the direction of Soviet efforts. On the contrary, remarkable tactical agility and flexibility are observed steering a shrewd course with the security and self-interest of the Soviet Union foremost in mind. The Soviets adopted a realistic policy which took advantage of opportunities made available by occasional lapses of both Western determination and Iranian resistance. This paper has tried to show that Russian planners did not necessarily want to take over Iran but, rather, wanted to gain a position of influence that would neutralize the area and give the Soviets a voice in the making of decisions on Iranian problems. Also, the United Nations, led by the United States, is shown as supporting Iranian resistance to Soviet blatant activity.

During 1941-1957 the Soviets undoubtedly learned that blatant political pressure would not win for them a position of influence in Iran. The United States learned the lesson that we must keep up our support of Iranian resistance to Soviet pressurizing methods. Basic to this Soviet pressure strategy is the idea of probing for weak spots. Since Iran is chronically weak this may be one of the reasons the Soviets probe there. If the West would keep an eye on the Azerbaijanis and Kurds as well as the Tudeh Party and the Soviet Embassy in Teheran, we might receive some key to future Soviet activity in Iran. Applying the lessons learned in Iran to the broader international scene, it would

seem wise for the West to keep an eye on minority groups everywhere, upon Soviet Embassy activities, and upon the infiltration of local governments by the local Communist Party. Watching these groups may give us some key as to the time and place when Soviet strategy, similar to that applied in Iran, may be tried elsewhere.

Microfilm \$3.65; Xerox \$12.40. 284 pages.

POLITICAL SCIENCE, PUBLIC  
ADMINISTRATIONSCIENTISTS IN GOVERNMENT: A BACKGROUND  
STUDY OF THE RETENTION OF SCIENTIFIC  
PERSONNEL IN FEDERAL EMPLOYMENT

(L. C. Card No. Mic 58-2812)

Earl Wayne Lindveit, Ph.D.  
The American University, 1958

**Problem.** The Federal Government is a major employer of scientific personnel in the United States, particularly in the fields of research and development and related scientific activities. The growing demand for scientific personnel in public as well as in private employment has created a shortage of manpower in these scientific areas which makes acute the retention of such personnel. This dissertation is concerned with analyzing and describing, on the basis of available data, certain aspects of the development, nature, and extent of the problem of retaining civilian scientific personnel in Federal employment, during various periods between World War II and fiscal year 1957, and also with proposing solutions to some of the retention problem areas that exist.

**Procedure.** The research methods employed in the dissertation include the historical method, to explore the background of the retention problem and give perspective to the factors bearing upon its development, and the statistical method, to present and interpret various quantitative data in order to help determine the nature of the retention problem.

**Results.** The research indicated that the analysis of turnover rates, as turnover is normally measured, is of only limited value in understanding and improving the problem of retention as it applies to the Federal Government's scientific personnel. Turnover was seen to be a symptom of a larger and more complex problem that also included the education and training of scientists and the resultant supply and demand for such personnel in the Federal Government and in the private economy. It was found that the Federal Government did not have available on a continuing basis the kinds of current Government-wide data needed to make critical appraisals of, and to develop selective solutions to, problems of retention of scientific personnel in Federal employment. Except for several limited individual agency retention studies, sufficient data were not available to pinpoint problems of retention by classes and grades of scientific personnel, and other data were found to be needed in order to determine the remedial measures that should be taken to meet scientific manpower shortages. Specifically, the turnover

data available on the Government's scientific personnel did not reflect comparability, recency, costs, adequacy for purposes intended, trend value, net losses and gains, or effect of turnover on Government science programs. No central agency in the Federal Government has established a system that would provide such needed data for defining the retention problem in an operational manner, including identifying the factors involved and setting up a method for keeping so informed. Also, the Government does not appear to reflect a unified policy direction in its scientific manpower activities or to possess appropriate machinery for providing overall leadership in meeting retention problems. Further, the Government, operating in a Legislative-Executive environment, does not have enough flexibility to meet competition for personnel in the scientific manpower field, including salaries and other benefits.

**Conclusions.** There is an indicated need for obtaining on a continuous basis, through the establishment of an effective reporting system, accurate and current diagnostic data, by various breakdowns and according to a number of specific categories of information, on the retention of scientific personnel in Federal employment. Also seen was the need for new or expanded Federal Government organization to stimulate appropriate action for adequate scientific manpower policy formulation efforts. Further, it was indicated that a thorough analysis and appraisal of the Federal Government's salary structure and its underlying philosophy should be made, particularly with reference to the salaries of civilian scientific personnel and to the more favorable employment position occupied by private scientific research organizations operating under contract with the Government.

Microfilm \$3.35; Xerox \$11.40. 257 pages.

**MISSION AND ORGANIZATION OF THE  
ARMY NATIONAL GUARD OF THE  
UNITED STATES: WITH EMPHASIS ON  
THE PERIOD SINCE 1952**

(L. C. Card No. Mic 58-2821)

Chester Morrill Jr., Ph.D.  
The American University, 1958

**Statement of the problem**

This dissertation concerns what the Guard has been and is now; the legal basis of the Guard and how it should be improved; what the mission of the Guard is; whether there are primary and secondary missions, and if so, what they are; whether there are separate Federal and State missions, and if so, what they are; what Guard organization is, especially since 1952; what supervisory, regulatory, and inspectional controls exist, over the Guard and in the Guard; and the adequacy of Guard organization as related to its mission and as conditioned by controls and other influences.

**Procedure and methods**

Observational, historical, and statistical methods have been used. The purpose of the study is an administrative review and analysis of the mission and organization of the Army National Guard of the United States with emphasis on the period since 1952.

**Conclusions**

History proved that unorganized militia by itself could not be depended upon. Furthermore, it became apparent that organized militia without Federal support was not the panacea that had been sought as a substitute for a regular military establishment. A knowledge of history from the earliest American militia origins to the present day is desirable. The Guard has not been perfected, but is available and competent to fulfill many of its responsibilities.

The militia laws have been the outgrowth of bills of rights, articles of government, and a famous declaration. The Guard is founded upon a body of law; it is hoped that some future codification will provide clarification, without which a lengthy narrative is necessary for an understanding of the Guard as it is today.

A recognized authority should write a statement of what the Guard is to guard, and this statement should envisage some feeling as to how National the Guard ought to be; a statement of why there is a Guard, and what it is for, should be issued. Such a statement should be related to the distribution of national resources.

Consideration should be given to the allotment of more divisions and brigades on the troop basis. Relatively unnecessary companies and detachments should be revaluated with a view to elimination. Amalgamation of units should be weighed in this connection; the merger of Guard and Army Reserve units in some instances might be possible.

Insufficient units of certain types have existed, such as military police and transportation companies, to satisfy regional and local needs. Amendments should be made to grant reasonable requests for such units if justified in the light of catastrophe conditions and civilian defense plans.

Planning, programming, and budgeting should be consistent, integrated, and Federally assisted to the end that better Federal-State-Local cooperation will be attained.

The headquarters, company, battery, or detachment commander should try to learn why men quit; statistics should be compiled and programs adapted to the needs indicated by a system of exit interviews.

A list of long term goals, in both quantitative and qualitative terms, should be issued. Some mention should be made of how many days are required to get Guard units ready for mobilization.

Public opinion is both basis and boost for the Guard. Without local backing and community approval, the Guard would not still be in existence. In view of this democratic support, it would be unwise to lose this source of organized military manpower. The Guard is relatively ready for mobilization and is generally satisfactorily prepared for war, subject to improvement in the statement of its mission and consequently in its organizational structures.

Microfilm \$3.25; Xerox \$11.00. 249 pages.

## PSYCHOLOGY

### PSYCHOLOGY, GENERAL

#### A FACTORIAL ANALYSIS OF THE VOCATIONAL INTERESTS OF TWO HUNDRED ADULT FEMALE STUDENTS

(L. C. Card No. Mic 58-1972)

Josephine Arns, Ed.D.  
Temple University, 1958

The purpose of this study was to identify and measure the vocational interest factors as reflected by an estimate of factor loadings on individual inventory items of the Temple Vocational Inventory for a population of two hundred adult female students of the various divisions of Temple University.

Up to the present time there have been very few studies on the vocational interests of women. Little is known about the basic interests of women and how they differ from those of men. Since women now comprise a considerable part of our labor force, their importance in the area of employment has increased tremendously. Accordingly, more emphasis must be placed on the vocational and educational guidance of females. This necessitates more knowledge of the vocational interests of women, since the measurement and analysis of interests is one of the key techniques in vocational and educational counseling.

The first step in the present investigation was the development of a new vocational interest inventory based on job-titles and action-verb phrases contained in job definitions in the Dictionary of Occupational Titles. A number of personality items from inventories developed by Guilford and Martin as well as by Guilford and Zimmerman were used in modified form. Modifications of environmental and associational items developed by Miner were also included. The writer is one of the co-authors of this 300-item inventory, the Temple Vocational Inventory.

An investigation was made using responses to individual items in the Temple Vocational Inventory by a sample of vocationally experienced and inexperienced women. These women were students in various day and evening classes in the colleges and divisions of Temple University. All of them were at least high school graduates. The sample of two hundred women included one hundred and forty-five who were vocationally experienced and fifty-five who were inexperienced. Of the experienced group, fifty-five women had been employed for a period of from four months to two years; the remaining ninety had been employed more than two years. Although the age range was from under twenty years to over fifty, a slight majority of the women were in the twenty to twenty-nine year age group.

The Wherry-Winer indirect method of factor analysis was used to identify the factors and to obtain the factor loadings of the individual inventory items. The obtained factor loadings of the items in the interest inventory were employed in drawing conclusions regarding the nature of the obtained interest factors.

There appear to be seven basic interest factors. Each factor has a number of items with significant factor loadings. The factors, in order of importance on the basis of their total communalities, together with examples of items with high factor loadings were as follows:-

Factor	Name	Examples - Occupational Titles
I	Clerical	Office Clerk, Bookkeeper, Typist, Statistical Clerk, Cashier
II	Agriculture-Outdoor	Nurseryman, Forest Ranger, Landscape Gardener, Farmer, Rancher
III	Technical	Designer, Artists, Lawyer, Stenographer, Architect
IV	Professional Service	Professor, Lawyer, Editor, Psychologist, Interviewer
V	Aesthetic	Designer, Artist, Entertainer, Musician, Author
VI	Personal Service	Beautician, Stewardess, Sales Clerk, Receptionist, Office Clerk
VII	Health Service	Physician, Laboratory Technician, Pharmacist, Veterinarian, Dentist

Five interest factors which originally were thought to be present, but did not remain as basic group factors after the factor analysis, were: Scientific-Technical, Managerial-Supervisory, Sales-Persuasive-Verbal, Business (High Level) and Crafts.

The original 300 items in the inventory were reduced to 93 on the basis of their communalities. All personality and environmental items were deleted on the basis of their not having significant loadings on any of the factors.

Microfilm \$2.00; Xerox \$5.00. 98 pages.

#### QUANTITATIVE AND QUALITATIVE BEHAVIORAL CHANGES IN THE RHESUS MONKEY AFTER LESIONS OF THE CAUDATE NUCLEUS

(L. C. Card No. Mic 58-2840)

Waid Hampton Dean, Ph.D.  
Louisiana State University, 1958

Supervisor: Professor Thomas W. Richards

This experiment is an investigation of the behavioral changes occurring following lesions of the caudate nucleus. Surgical lesions of the caudate nucleus and other structures were produced in five rhesus monkeys. Quantitative and qualitative disturbances in behavior were observed

after operation. Drugs known to have an effect on the central nervous system were used in further evaluation of post-operative behavior. Finally, pathological confirmation of the location and dimensions of the surgical lesions was ascertained.

The conclusions of the present experiment are as follows:

1. Restricted bilateral caudate lesions are followed by a specific loss in learned abilities.
2. Caudate lesions produced no change in color discrimination ability, while delayed response ability is impaired.
3. Unilateral lesions of the caudate result in a well defined partial loss of delayed response ability.
4. The excitant drug phenidylate restores delayed response performance. The tranquilizing agent reserpine also restores delayed response, although not as effectively.
5. Caudate lesions produce a defect in memory which is followed by difficulty in performing tasks where forced time delay is involved.
6. Correlation between anatomical damage of the caudate and loss of delayed response abilities is good.

Microfilm \$2.05; Xerox \$7.20. 154 pages.

#### MANAGERIAL LEADERSHIP STYLES: SOME DIMENSIONS, DETERMINANTS AND BEHAVIORAL CORRELATES

(L. C. Card No. Mic 58-3652)

James Kelso Dent, Ph.D.  
University of Michigan, 1958

This exploration into the leadership styles of total establishments (places of work) utilizes data from an interview survey of top management executives in 213 business establishments. Included are establishments with more than 50 employees in all types of industry in five communities. It is assumed that there are at least two dimensions underlying the democratic-authoritarian continuum: common interest and joint decision-making.

The manager's style is inferred from his perceptions of his relations with his employees on these two dimensions. There are four operational measures: perceived common interest with employees, i.e., perceptions of employee effort on the job and of their interest in take-home money or other things about the job; perceived common interest with the union, i.e., perceptions of the union as pulling for the same or different things from management; perceived say of employees in wages and working conditions; and perceived say of supervisors in company policy.

There is a positive relation between perceived common interest with employees and perceived say of employees in nonunion establishments, but no relation in union establishments. However, in the latter, both variables are positively related to perceived common interest with the union. Perceived say of supervisors is generally not related to the other variables.

The available data permit testing of hypotheses in the following areas:

#### Leader and Follower Behavior.

**Hypothesis 1** Organizational activities in the area of employee welfare will be greater in establishments where the manager perceives more common interest and similarly where he perceives more employee say.

This is confirmed in both union and nonunion establishments for perceived common interest and perceived say of employees but not for the other measures.

**Hypothesis 2** Unstable membership in organized groups is associated with a perception of little common interest, and with little joint decision-making with the followers.

The replacement rate, employees leaving and replaced, is negatively related to employee say in nonunion establishments. Perceived say of supervisors in union establishments is negatively related to variations in employment over a nine-year period.

#### Organizational Determinants.

**Hypothesis 3** In union establishments, the greater the degree of unionization the more the manager will perceive employee say in wages and working conditions.

The proportion of employees who are union members is positively related to perceived say of employees.

**Hypothesis 4** The smaller the social gap between manager and employee, the more likely the manager is to perceive common interests and employee say.

The proportion of employees who are white-collar, professional, and supervisory is positively related to perceived common interest in union establishments.

**Hypothesis 5** In very small, and in very large establishments, managers will perceive more common interest and more say than in middle-sized establishments.

This is confirmed in nonunion establishments for perceived common interest and perceived say of employees, while perceived say of supervisors is negatively related to the size of establishment. In union establishments, perceived common interest with employees is positively related to size while perceived say is U-shaped but inverted from the prediction.

**Hypothesis 6** Owner managers will tend to greater variation (less conformity) in their positions on the two dimensions than will professional managers.

This is not confirmed. Owner managers see high common interest with employees in nonunion establishments and low common interest in union establishments. Professional manager's perceptions spread over the entire scale rather than clustering at the extremes, and are similar in union and nonunion establishments.

Hypothesis 7 When the members' contribution is relatively rare and difficult to replace, the leader will tend to see joint decision-making.

In nonunion establishments, the higher the wages the more the managers see their employees as having a say.

Microfilm \$2.00; Xerox \$5.80. 118 pages.

### TOWARDS A MATHEMATICAL THEORY OF COGNITIVE PROCESSES

(L. C. Card No. Mic 58-2343)

James Buford MacQueen, Ph.D.  
University of Oregon, 1958

Adviser: R. F. Fagol

This thesis constitutes an attempt to formulate a mathematical approach to the study of cognitive processes. The approach is derived from the consideration of the mathematical theory of stochastic processes in relation to the cognitive or organizational point of view within psychology. Consideration of these two lines of theoretical development leads to ways of dealing with a variety of problems: The problem of the relation of cognition to other psychological process such as perception, the problem of the choice of behavior categories, the problem of describing the essential features of "molar" behavior, the problem of purpose and direction in behavior, the problem of the relation between psychological processes and objective processes, the problem of the relation between learning, motivation, and performance, the problem of developing a systematic and quantitative theory of thinking, the problem of describing the phenomenal world, and the problem of analyzing the interpersonal situation. The ways of dealing with these problems which are indicated by joint consideration of the theory of stochastic processes on the one hand and the cognitive point of view on the other are presented and discussed.

In addition, a specific model for thinking is presented and experiments designed to test the model are reported. In this model it is assumed that the subject is faced with a set of objective possible actions; given each of these possible actions and their outcomes, there is another set of possible actions and outcomes, and given each of these, there is again another set of possible actions and outcomes, etc. These sets can be arranged naturally in the form of a mathematical tree. It is then assumed that in thinking the subject represents to himself these possible actions and their consequences; accordingly the subject's representations (thoughts, ideas, hypotheses) also have the structure, as possibilities, of a mathematical tree, and this tree is called a "psychological tree." This tree does not correspond perfectly to the tree of objective possibilities, however, since there may occur representations of actions and consequences which are in no meaningful sense objectively possible. In general, to obtain a model of the processes of thinking the psychological tree is used as the basis for generating a stochastic process. A moving point is allowed to move through the psychological tree in a sort of "random walk," the probabilities of each move being determined in accordance with certain hypotheses concerning

thought processes. A move of this point on to a branch of the tree is assumed to correspond to the occurrence of the thought of the corresponding possible action and its outcome. When the moving point arrives at certain specified branches which correspond to thoughts of solutions, it is assumed that an overt solution indicating response occurs. Thus the mean number of moves of the point becomes an index of solution time.

Three different models of this sort were tested by comparing the theoretical mean number of moves with empirical solutions times for a series of thought problems. Subjects were required to play a number of "mental games" of the same general sort and their actual solution times were determined. For all three models, correlations over problems between empirical solutions times and theoretical measures were positive in two separate experiments involving different games and subjects. Results of a pilot study were also positive. The models also predict the variance in solution time. Here the correlations were generally positive but were not statistically significant. These results are interpreted as indicating the fruitfulness of the approach.

Microfilm \$2.55; Xerox \$8.80. 193 pages.

### CONCEPTUAL VARIABLE ANALYSIS OF RURAL MIGRATION IN IOWA

(L. C. Card No. Mic 58-3010)

Mohamed Mohiey Eldin Nasrat, Ph.D.  
Iowa State College, 1958

Supervisor: Roy E. Wakeley

A review of previous literature indicated the lack of systematic theory which would provide a general framework for dynamic analysis of migration. Therefore, the problem of this dissertation has been to suggest a general systematic theory and test it by means of available data on migration and other related factors, by the method of conceptual variable analysis.

The general hypothesis that cohesion varies indirectly with deprivation was suggested and tested in the present study. Cohesion was defined as the degree to which the units in the social system accept their prescribed roles by the system. Deprivation was defined as the degree to which achievement expectations exceed achievement actualities. A measure for each of the conceptual variables was developed for this study from published data on rural migration and other economic variables for Iowa counties. Cohesion was measured negatively by net migration index defined as the net change of population through migration in an Iowa county in the decade 1940-50 as percentage of 1940 population. The following coefficients were developed as indexes for deprivation: 1. coefficient of variation, a positive index, which is the variance of farm-operator family level-of-living indexes during the period 1930 to 1950; 2. coefficient of deprivation, a negative index, which is the percentage increase of per capita income from 1939 to 1947; and 3. coefficient of relative rewards, a negative index, which is the ratio between per capita income in 1947 for each county in Iowa and the per capita income for the State of Iowa in the same year.

Empirically, the hypothesized indirect relationship between cohesion and deprivation was tested and measured by the simple correlations that exist between net migration index and the indexes of deprivation. The three coefficients were used also as elements in a total index for deprivation in a multiple regression analysis.

Analysis of the data indicated that the relationships between the dependent variable and the three independent variables were in the expected direction which was suggested by the theory. Relationships between net migration index and both the coefficient of deprivation and the coefficient of relative rewards were judged statistically significant. While the coefficient of variation would not be considered significantly correlated with net migration index on the county basis, significant relationship between these two indexes were found when the state economic area was used as the unit for analysis.

In the multiple correlation analysis, approximately 32 per cent of the total variation in the dependent variable was accounted for by covariation in the three independent variables for the 99 counties in Iowa.

The relationships between the variables have been examined in more detail for groups of Iowa counties, classified according to the size of the largest incorporated center that exists in each county, by the simple and multiple regression techniques.

The regression equations for all counties in Iowa and for the other groups of counties were used in predicting the amount of net migration for the counties.

The present study, while it is of a preliminary nature, constitutes a functional approach through the use of conceptual variable analysis which will help as a method of population analysis and contribute to the development of systematic integrated theory in sociology.

Microfilm \$2.00; Xerox \$5.20. 104 pages.

## PSYCHOLOGY, CLINICAL

### AN INVESTIGATION OF THE USEFULNESS OF SELF-CONCEPT THEORY IN EXPLAINING SOME ASPECTS OF THE RESULTS OF CHLORPROMAZINE TREATMENT OF SCHIZOPHRENICS

(L. C. Card No. Mic 58-1197)

Loran Francis Baxter, Ph.D.  
University of Colorado, 1957

Supervisor: Professor Victor C. Raimy

The present study was an attempt to demonstrate that predictions made from self-concept theory about changes in the self-concept following chlorpromazine treatment could be empirically validated on a schizophrenic population. Ten measures were administered before and after an experimental period to three groups of hospitalized schizophrenic patients. Six of the measures dealt with Q-sorts which reflected a subject's concept of his "self," his "ideal self," and his concept of the "average other person." The items used in the Q-sorts were fifty self-referent items chosen from a large population of such

statements. These items were sorted by each subject, both before and after the experimental period, for each of the above concepts. In addition to the Q-sort measures, an S test, designed by the author and composed of a further list of fifty self-referent items taken from the above population of items, was administered as a true-false test to determine change in self-concept during the experimental period. The Taylor Manifest Anxiety Scale was administered twice to ascertain changes in self-concept and reduction of anxiety. The length of time required for each subject to complete the Q-sort for each of the above three frames of reference was recorded for both administrations of the sort. A final measure was a subjective evaluation of change in patient behavior following the experimental period, made by patient supervisory personnel. The actual measures utilized were:

1. The self-ideal self correlation, indicating self-esteem (between Q-sorts for the concepts of self and ideal self).
2. The self-average other correlation (between the Q-sorts for the concepts of self and average other).
3. The ideal self-average other correlation (between the Q-sorts for the concepts of ideal self and average other).
4. The other-normal other correlation (between the Q-sorts for the average other and a normal other sort obtained from Chase).
5. The self-self correlation (between the Q-sort for the self frame of reference made before and after the experimental period). In addition the before and after self sorts were correlated with a normal self-sort obtained from Chase.
6. The S test score (the total number of self-referent items changed in the before and after testing).
7. The ideal self-ideal self correlation (between the before and after ideal self sorts). In addition the before and after ideal sorts were correlated with the normal self sort.
8. The Taylor Manifest Anxiety Scale (administered in group form to all subjects both before and after the experimental period).
9. The Q-sort time (the total length of time required to complete the three sorts).
10. The behavior ratings (completed on each subject by patient-supervisory staff following the experimental period).

In order to determine if the predicted change in self-concept would be brought about by chlorpromazine, the above measures were administered to sixty-seven hospitalized, male schizophrenics in a continuous treatment setting at a Veterans Administration hospital. Of this group, twenty-three were already regulated on chlorpromazine treatment, and no change was made in their care during the five-week experimental period. A second twenty-three were placed on an arbitrary dose of 100 mg. of chlorpromazine administered orally three times per day for the five-week experimental period. A third group of twenty-one received an identical appearing placebo during the experimental period. All subjects were retested at the end of the experimental period, and behavior ratings of

change were secured for each subject from the hospital personnel who had most individual contact with each.

The reliability of the measures was determined by the before and after scores of the chlorpromazine control group. Tests of significance of difference between the mean before and after difference scores were determined for the placebo and experimental chlorpromazine group on each measure.

The Q-sort measures, with the exception of the self-self, self-average other, ideal self-average other, and average other-normal other, indicated that the experimental chlorpromazine group experienced greater change in self-concept than did the placebo group. The self and ideal self of the experimental chlorpromazine group approached closer to the way that the normal person sees himself. Though there was considerable change in the self-concept of the placebo group over the experimental period, it was not in the direction of the normal self.

The other measures indicated significant self-concept changes in the experimental chlorpromazine group in the direction of a more normal, less maladjusted self-concept. The other two groups remained relatively stable, with the experimental control group generally the best adjusted of the three, the placebo group the least adjusted.

A number of limitations of the study such as the limited length of experimental time, chronicity of the schizophrenic condition, arbitrary nature of dosage, lack of random selection of subjects, et cetera, were discussed. With these limitations in mind, the following tentative conclusion was offered.

The major conclusion of this study was that self-concept theory can be used to make predictions about changes in the self-concept of schizophrenic patients. This conclusion was made on the basis of the following results.

As was predicted:

1. The subjects in the chlorpromazine group experienced a decrease in anxiety.
2. They became more efficient and were rated as improved.
3. They tended to see themselves as more like the normal person sees himself.
4. Their self-esteem increased as their perceived self approached what they wanted to be like.

The process by which chlorpromazine brings about the above self-concept changes was speculated upon in the following manner:

1. Chlorpromazine chemically reduces the awareness of anxiety, thus permitting a change in the perception of the flow of internal stimuli and hence a change in the perception of the self-concept.
2. Without the need for a defense against anxiety, less preoccupation with the need for defense in necessary permitting more efficient behavior, better learning, and less symptomatic behavior.

Suggestions for possible future research involving further investigation of different aspects of the self-concept in schizophrenia were suggested. In addition, possible implications for the use of psychotherapy in conjunction with chlorpromazine to bring about further and more permanent changes in the self-concept were discussed.

Microfilm \$2.00; Xerox \$6.80. 144 pages.

## INTERRELATIONSHIPS OF AUTONOMIC AND PERSONALITY VARIABLES

(L. C. Card No. Mic 58-3637)

Leslie Berger, Ph.D.  
University of Michigan, 1958

The present study was undertaken to investigate systematically some relationships between psychological and physiological variables.

Measures of autonomic functioning (skin resistance, heart rate, and respiration rate) at rest and under three stresses were linked to a battery of personality tests (Blacky Pictures and its associated Defense Preference Inquiry, the Edwards Personal Preference Schedule, and the Cattell 16 PF). The subjects were 30 male patients on psychiatric wards of a VA hospital, and 27 male college students.

A matrix of intercorrelations, containing phi coefficients from 54 personality variables and 18 physiological variables, was prepared for each of the two samples. The 40 most promising variables were retained for subsequent factor analysis. The obtained factors were rotated by the quartimax method, and comparison with Thurstone's criteria revealed the existence of simple structure.

Five pairs of rotated factors were sufficiently similar psychologically in the two samples to appear to be cross-validated. These factors were tentatively identified as follows:

- Factor I: Maternal Fixation.
- Factor II: Passive Sexual Role vs. Lack of Sexual Confusion.
- Factor III: Anal Expulsiveness vs. Anal Retentiveness.
- Factor IV: Interpersonal Hostility vs. Congeniality.
- Factor V: Purposeful Giving.

One other factor (Reactive Nurturance) seemed to correspond to Cattell's second order factor Unbroken Success. Of the remaining 15 factors eight were felt to be meaningful and interpretable, whereas seven were not amenable to interpretation at the present time. The eight were named as follows: Aggressive Sexual Confusion; Impulse Expression; Suppressed Emotionality; Castration Anxiety; Rejection of Interpersonal Attachment; Cold Pressor Test Reaction; Inhibited Desire for Mothering; and Neuroticism vs. Adjustment.

One major implication of the findings is that they provide further empirical support to theory which emphasizes the unity and organization of personality. The data suggest that maladjustment and tension relate to hyperfunction in physiological organs at rest. Furthermore, certain specific personality characteristics may be associated with specific organ dysfunctions.

A number of interesting interrelationships were noted between physiological reaction to stress and personality. Galvanic Skin Reflex (GSR) appeared to be linked primarily to the inhibition of expression of impulses regardless of the specific nature of the conflict. An increase in respiration rate under stress was found to be related to anxiety and hostility, whereas passive dependence correlated with decreased respiration rate. Dependence and preference for regression as a defense corresponded to tendencies to respond to stress with a decreased heart rate.

The results also shed some light on autonomic pattern specificity. Since the autonomic functions appear to vary independently and to load on separate factors, the concept of specialized autonomic balance is supported. Here the data are in agreement with Lacey's formulation. Specificity across all stresses under all conditions, however, is doubtful. It seems as if certain personality patterns are related to specific autonomic responses under all "stresses," whereas other characteristics correspond to specific responses under specific stresses.

Autonomic functioning was found to be related to specific personality patterns in most instances. In some cases, however, it does appear as if some types of autonomic reactivity may be determined almost exclusively by genetic and/or constitutional factors. Thus it seems likely that both constitution and personality play a part in physiological responses.

In conclusion it is suggested that future psychosomatic research be oriented toward the operation of specific personality constellations in carefully delimited stress situations. Microfilm \$2.00; Xerox \$6.40. 132 pages.

#### THE INFLUENCE OF ANXIETY LEVEL, INITIAL RESPONSE PREFERENCE, AND ACQUIRED RESPONSE PREFERENCE IN SERIAL NONSENSE LEARNING

(L. C. Card No. Mic 58-2887)

Alvin Stanley Bernstein, Ph.D.  
The University of Buffalo, 1958

##### Purposes of Study:

1. to permit detailed testing in a complex learning situation of the Hull-Spence theory describing anxiety as a nondirective energizer of behavior.
2. to permit exploration of:
  - a) the influence on learning of personal pre-learning response preference ("brought through the door" by S), and of subsequently acquired response preference.
  - b) the free-choice (FC) behavior of anxious (HA) and nonanxious (LA) Ss.

##### Method:

Anxiety was defined in terms of Taylor's Manifest Anxiety Scale (MAS). Out of a population of University of Buffalo students, those scoring in the top 20% comprised the HA sample, those in the bottom 25% the LA sample. These 2 samples were each then divided into 2 subgroups- a 1-free choice (1-FC) and a 15-free choice (15-FC) group, making 4 experimental groups in all (HA1, HA15, LA1, LA15), each with 25 Ss essentially alike in age, IQ, and education.

The learning task was a 12-unit double-alternative verbal maze, consisting of paired nonsense syllables. Syllable pairs were serially exposed in uninterrupted sequence for 3" each by a Hull-type memory drum.

Ss received 3 tasks (separated by 60" rest periods): 1) free choice trials 2) first learning (LI) 3) second learning (LII). In all 3 the same syllable pairs were shown, and S asked to spell whichever one he thought 'right' in each pair. In the FC trials E remained silent, while in LI and LII E replied 'Right' whenever S spelled the correct syllable, remaining silent only for errors.

In the FC trials, S was told to guess the right one in each pair- to spell whichever one he preferred. The 1-FC groups made 1 such response at each choice point, the 15-FC groups made 15. The response of each 1-FC S to each pair defined that S's initial dominant R at that point. For 15-FC Ss, a response was considered initially dominant at any given point if it was repeated 10 or more times in the 15 trials.

For LI, (by prearranged pattern), each S's dominant response was retained as correct for that S on 6 choice points (correct initial dominance): on the remaining 6, each S's dominant response was incorrect (incorrect initial dominance). (The pattern was reversed for odd-even Ss in each group, both here and in the test of acquired dominance.) S then learned LI to a criterion of 2 successive errorless runs through the entire maze.

The response learned on LI remained correct on LII on 6 points (correct acquired dominance), and became incorrect on the remaining 6 pairs (incorrect acquired dominance). Further, one-half the correct acquired dominance points were also correct with reference to each S's particular initial response preference, while the other one-half were opposed to such initial preferences. The same held for the 6 incorrect acquired dominant points. It was thus possible to study the effect on LII of- 1) acquired dominance with the effects of initial dominance balanced 2) initial dominance with the effects of acquired dominance balanced 3) all possible interactions between them.

LII was then learned to the same criterion as LI.

##### Results:

1. There was no support for the Hull-Spence theory:- HA Ss did not make either less error than LA Ss under correct dominance or more errors under incorrect dominance- whether on LI or LII, under initial or acquired dominance.
2. The FC performance of all Ss (HA and LA alike) was highly perseverative: given 15 FC trials, Ss repeated their own initial response to a point at least 10 times in some 90% of the cases.
3. On LI, LA15 Ss made significantly fewer errors than LA1 Ss, while HA15 Ss made significantly more error than HA1. These findings were essentially due to differences under correct initial dominance.
4. Learning on LI and LII was significantly facilitated for all groups under correct initial-, and acquired response dominance respectively. Incorrect dominance did not appear to impair learning markedly however.
5. HA Ss made more errors on LI than did LA Ss, but tended to make less than LA Ss on LII. On LII HA Ss reacted entirely in terms of acquired response dominance: initial dominance was no longer of any significance. For LA Ss however, initial response preference remained a significant variable on LII.
6. A cognitive-selective interpretation was suggested, such that HA Ss are reluctant to act upon their personal, externally unsupported inclinations, restricting their attention wherever possible to externally authorized possibilities alone. LA Ss were more apt to consider a range of possibilities, among which was their own 'best guess'. Mandler's work on response factors was noted, with the suggestion that this cognitive factor be added to it, such that, when a number of equally well differentiated responses are comitantly available, Ss may consistently favor one type over another.

Microfilm \$2.20; Xerox \$7.80. 168 pages

**PATTERNS OF ROLE DOMINANCE AND  
CONFLICT IN THE INTERACTION OF PARENTS  
OF SCHIZOPHRENIC PATIENTS**

(L. C. Card No. Mic 58-2731)

Amerigo Farina, Ph.D.  
Duke University, 1958

Supervisor: Norman Garmezy

A situational test was employed to examine the patterns of role dominance and conflict of parents of male schizophrenic Good and Poor premorbid patients and a control group of parents of male tubercular, non-psychiatric patients. The parents were required to respond to 12 hypothetical situations related to problems of child rearing. All parents first responded individually to the task, then, jointly with their spouses under a task set to arrive at a mutually acceptable resolution. The variable of dominance was inferred from measures such as the ratio of father's to mother's speaking time, etc. and conflict was inferred from measures such as frequency of interruptions; etc.

The three hypotheses which were advanced are as follows.

Hypothesis I. Parents of schizophrenic patients would show more highly structured patterns of individual role dominance relative to the parents of "normal" sons.

Hypothesis II. The interactions of parents of Good Premorbid schizophrenic patients would reflect father dominance whereas mother dominance would characterize the interaction patterns of Poor Premorbid parents. On the other hand normal control parents would be expected to share the dominance role in the family and to manifest a more equalitarian relationship.

Hypothesis III. Conflict between parents would be greatest in the schizophrenic groups and least apparent among the normal control Ss.

Hypotheses I and II were substantiated and the results gave partial support for Hypothesis III (the Poor group parents gave evidence of greater conflict than the controls). The patterns of family relationships for the groups were as follows.

1. Good Premorbid Families: Father strongly ascendant; mother weak and submissive; minimal degree of overt discord present.
2. Poor Premorbid Families: Mother markedly dominant; father shows tendency toward submission; marked conflict and discord.
3. Normal Families: A slight tendency toward maternal dominance but sharing of authority is also present; little evidence of conflict or discord.

Some evidence was found in the schizophrenic group of a relationship between equality of parental authority role and extent of conflict between the parents. This evidence was interpreted as signifying greater dominance needs in the parents of the schizophrenic patients relative to controls.

The major results are discussed in terms of two questions: 1) How do these parental behaviors help to understand behavioral differences within the total group of schizophrenic patients, and 2) how might they play a role in the etiology of schizophrenia. The importance of the process of identification of son with father is discussed in detail. Microfilm \$2.60; Xerox \$9.00. 199 pages.

**DIFFERENTIAL RORSCHACH CONFIGURATIONS  
OF SUICIDAL PSYCHIATRIC PATIENTS:  
A PSYCHOLOGICAL STUDY OF THREATENED,  
ATTEMPTED, AND SUCCESSFUL SUICIDES**

(L. C. Card No. Mic 58-2823)

Murray S. Fleischer, Ph.D.  
Yeshiva University, 1957

This research study was primarily designed to analyze and compare the Rorschach test records of one hundred male and female psychiatric patients classified into four equally divided groups of non-suicidal patients and threatened, attempted, and successful suicide patients, for the purpose of determining potentially suicidal behavior through the use of twenty-five allegedly significant differential Rorschach configurations.

The results revealed:

1. On the basis of the frequency occurrence of specified Rorschach configurations, there are statistically significant differences existing among suicidal psychiatric patients classified on a psychological continuum ranging from successful suicide to non-suicide, and containing intermediate groups categorized as suicidal attempt and suicidal threat. A general grouping of individuals under the comprehensive classification of "suicidal" tends to mask salient distinctions existing among such suicidal individuals.

2. The most appropriate suicidal Rorschach configurations to discern and detect suicidal propensities are those of Beck, and of Hertz.

3. A derived Suicidal Detection Configuration, combining the most efficient predictor variables from the Beck and the Hertz configurations, was more efficient in differentiating suicides from non-suicides than either the Beck or the Hertz configurations applied singly.

4. A derived Successful Suicide Differential Configuration consisting of the six most sensitive patterns of the Hertz configuration was able to significantly differentiate successful suicidal behavior from other forms of suicidal manifestations.

5. The present findings require further application and analysis to new and larger populations.

Microfilm \$2.00; Xerox \$6.80. 141 pages.

# CLIENT AND COUNSELOR VARIABLES RELATED TO OUTCOME OF COUNSELING

(L. C. Card No. Mic 58-3669)

Ida Mary Hackney, Ph.D.  
University of Michigan, 1958

This study is an attempt to examine client and counselor variables related to length of counseling contact and appropriateness of early termination, using hypotheses derived from the psychoanalytic theory of behavioral manifestations of anxiety.

The client variables studied were:

1. Level of anxiety, as measured by the Welsh and Windle indices derived from the Minnesota Multiphasic Personality Inventory.
2. Levels of hostility and passivity, as measured by codings of initial interview behavior on the interpersonal system developed by Leary et al.

The counselor variables studied were:

1. Level of hostility ("judged hostility") derived from inter-judge agreement on ratings of the counselors in the study.
2. Level of hostility ("interview hostility") as measured by codings of initial interview behavior in the same manner as for client behavior.

The subjects were 51 male undergraduates presenting problems of vocational choice and academic difficulties to the Counseling Division of the Bureau of Psychological Services at the University of Michigan.

Eleven hypotheses derived from the psychoanalytic theory of anxiety were tested. The findings were:

1. Level of client anxiety was found to be related to length of counseling contact.
2. Level of client anxiety was found to be related to appropriateness of early termination.
3. Level of counselor "judged hostility" was not found to be related to length of contact.
4. Level of counselor "judged hostility" was not found to be related to appropriateness of early termination.
5. (a) A slight trend toward a positive relationship was found between level of client anxiety and level of client hostility in initial interview.  
(b) No relationship was found between level of client anxiety and level of client passivity in initial interview.  
(c) No relationship was found between levels of client hostility and passivity in initial interview.
6. A significant relationship was found between counselor "judged hostility" and "interview hostility".
7. No relationship was found between level of counselor "interview hostility" and levels of hostility and passivity of anxious clients.
8. Levels of client hostility and passivity in initial interview were not found to be related to length of counseling contact.
9. Levels of client hostility and passivity in initial interview were not found to be related to appropriateness of early termination.

10. Level of counselor "interview hostility" was not found to be related to length of contact.

11. Level of counselor "interview hostility" was found to be related to appropriateness of early termination.

It was concluded that certain client and counselor variables can be useful in studying length of counseling contact and appropriateness of early termination. It was further concluded that:

1. It is less accurate and meaningful to study predictions from isolated client and counselor variables, than the combinations of such variables which incorporate the interrelationships of anxiety and hostility involved in the theory.
2. Evidence from actual interview behavior is required in order to make accurate predictions to counseling outcome.

The criterion variable of appropriateness of termination requires further study in order to assess its validity and clinical usefulness.

Microfilm \$2.00; Xerox \$4.80. 94 pages.

## AN EMPIRICAL INVESTIGATION OF THE PERSONALITY CHARACTERISTICS AND ATTITUDES OF THE PARENTS OF CHILDREN WHO STUTTER

(Publication No. 22,172)

Audrey Rose Holliday, Ph.D.  
University of Washington, 1957

This study tests the general hypothesis that the mothers and fathers of children who stutter differ significantly on certain personality and attitudinal variables from the mothers and fathers of children who do not stutter and who are, in so far as can be pragmatically determined, "normal," in other respects.

To implement a test of this hypothesis, standard research instruments measuring normal personality variables, parental attitudes toward children, and the tendency to give socially desirable responses to statements about personality, were administered to an experimental-group comprised of mothers and fathers of stutterers and to a control-group comprised of mothers and fathers of non-stutterers. The experimental-group mothers were matched with the control-group mothers on the variables of age and education; and the experimental-group fathers were matched with the control-group fathers on the variables of age, education, and occupation.

It has been frequently stressed in the literature that the fathers of children who stutter are dominating, punitive, rigid, and possessive in their attitudes toward their children and that the mothers of children who stutter are dominating, compulsive, rejecting, and interfering but depreciative of their abilities. The results of this study show that the fathers of stuttering children tend to be more compulsive and less exhibitionistic or out-going than the fathers of non-stuttering children and that the mothers of children who stutter are more aggressive than the mothers of non-stuttering children. The mothers of stuttering children are also more abasing in their attitudes toward

themselves than the mothers of children who do not stutter. The results also show that neither the mothers nor the fathers of children who stutter are more dominating than the mothers and fathers of children who do not stutter. The results also show that the fathers of stutterers are not more possessive or "pampering" in their attitudes towards their children than the fathers of non-stutterers.

The results also show that the sex-differences which prevail between the responses of the parents of non-stuttering children do not always prevail between the responses of the parents of stuttering children. In the families of non-stuttering children the father is significantly more aggressive and less flexible with the mother deferring and interesting herself in others' feelings and motives as well as her own. In the families of stuttering children the father is not the significantly more aggressive person who is less flexible and more structuring nor is the mother accepting of his leadership or significantly more interested than he in the motives and feelings of others.

The discussion stresses that both parents are significant figures in the child's environment and that it is not only the individual personality structure of each parent which is important but also that the pattern of behavior or interaction between the personalities of the two parents is important in setting the pattern of the child's interaction with the resulting environment.

Microfilm \$2.00; Xerox \$5.40. 110 pages. Mic 58-5079

#### THE INFLUENCE OF PSYCHOLOGICAL-MINDEDNESS AND INFORMATION ON ACCURACY OF PREDICTION

(L. C. Card No. Mic 58-2969)

Richard C. Jentsch, Ph.D.  
State University of Iowa, 1958

Chairman: Associate Professor Leonard D. Goodstein

Variables influencing the accuracy of predictions made by judges about other people have been previously investigated in several ways. The present study was concerned with manipulating the amount of information available to the judge prior to prediction and also with the effect of the psychological mindedness of the judge as measured by the Py scale of the California Psychological Inventory. Analysis of variance techniques were used to evaluate the results.

Tape recordings were made of the first counseling interviews of three male clients with personal problems who came to a university counseling service for help. From each of the client's interviews two ten minute portions of the tape recording were utilized in this experiment. The amount of information available to the judges, concerning any one client, prior to prediction was manipulated in the following way: Treatment I, Single Presentation--a group of judges listened to only one of the ten minute selections once; Treatment II, Repeat Presentation--another group of judges listened to one of the ten minute selections twice; Treatment III, Additional Presentation--another group of judges listened to both ten minute selections from one of the client's interviews. Any one judge only made one set of predictions; i.e., different judges were used in each of the treatment conditions for each of the three clients.

The judges employed in this study were students enrolled in an introductory psychology course who had scored in the upper or lower quarter of the distribution of Py scores obtained on administration of the scale to the entire class. Both male and female judges were used but their results were analyzed separately.

Three prediction instruments were employed, a Q-Sorts technique, a Self-Report Questionnaire, and a Multiple Choice Behavioral Postdiction Test. After listening to the part(s) of the interview, dependent upon which treatment they had been assigned to, the judges were asked to make the Q-Sorts as they thought the client had made it. Predictive accuracy was based on the correlation between the judges' sorts and the sorts made by the client just prior to his first counseling interview. After completing the Q-Sorts the judges were requested to fill out the true-false Self-Report Questionnaire as they thought the client had. Again their answers were checked with the answers given by the client just preceding the interview and the predictive accuracy was determined by the number of agreements. A 16 item four foil multiple choice test had been developed for this study covering the behavior of the three clients in various social situations and other aspects of the clients' behavior. The judges were requested to choose the correct answer for each item.

Subjects were run in small groups and were requested to follow a typescript of the interview as they listened. One hundred and eighty male judges and one hundred and forty-four female judges were analyzed, one half of each sex being high Py and one half low Py.

The results were:

- a) the various prediction instruments yielded inconsistent results and examination of their reliabilities revealed the Q-Sorts technique to be most useful and therefore the broader implications were derived solely from that measure;
- b) for the male judges increased amounts of information yielded increased accuracy of prediction for both high and low Py judges;
- c) the difference between high and low Py male judges failed to reach significance although it was in the expected direction;
- d) for female subjects, high Py judges improved with increased information while low Py judges became worse, an interaction for which no acceptable explanation could be proffered;
- e) female judges do not appear to predict more accurately than male judges;
- f) although there were significant differences in the accuracy of prediction for the three clients the differences remained essentially constant regardless of the amount of information, Py level, or sex of the judge. Microfilm \$2.00; Xerox \$5.40. 110 pages.

# INTERRELATIONSHIPS AMONG SEVERAL MEASURES OF VISUAL PERCEPTION IN MENTALLY RETARDED CHILDREN

(L. C. Card No. Mic 58-3686)

James Edwin Keller, Ph.D.  
University of Michigan, 1958

The diagnosis of brain-injury in children is difficult because of the lack of direct methods of assessing brain functioning. For immediate clinical and educational purposes it may be more profitable to focus attention on defining perceptual, cognitive, and motivational variables useful in predicting the mentally handicapped child's adjustment to various re-educative or therapeutic regimes. In keeping with this orientation, the present study represents an attempt to define a perceptual variable suggested by past research in brain-injury.

An attempt was made to determine whether, in a population of high-grade mentally retarded boys, a relatively low critical flicker frequency threshold is associated with difficulty in perceiving apparent movement in abstract figures, and with failure to report spiral aftereffect. Werner and Thuma have reported that brain-injured retarded boys, as compared to non-brain-injured, have significantly lower critical flicker frequency thresholds and are deficient in their ability to perceive apparent movement. The results of their studies are so striking and have been so widely accepted that an effort to replicate their work seemed warranted. In addition, other investigators have reported that these three perceptual measures reflect the presence of brain-injury in adult subjects. If the three perceptual measures are each sensitive to brain-injury because of their ability to reflect some central neurophysiological state, it is reasonable to predict that they will be significantly intercorrelated in a population containing an appreciable number of brain-injured individuals.

The present investigation was composed of two separate, but intimately related, studies. In Part I the relationships between measures of critical flicker frequency, apparent movement, and spiral aftereffect were studied in a population of high-grade mentally retarded boys similar to that studied by Werner and Thuma. No significant correlations were found between the perceptual threshold measures. The experience of securing perceptual thresholds from retarded subjects suggested that variables unrelated to neurophysiological functioning may play a decisive part in determining the responses of these intellectually inadequate individuals. In Part II, therefore, an alternative explanation for the Werner and Thuma findings was developed, and an experiment devised to test the adequacy of this explanation. It was assumed that in the Werner and Thuma studies the brain-injured and non-brain-injured groups differed in regard to impulse control, the brain-injured subjects tending to be more hyperactive and impulsive than the non-brain-injured. And the difference in perceptual threshold scores for the two groups was considered to be the result of the action of this uncontrolled factor of differences in hyperactivity. In the present study, therefore, it was hypothesized that nonhyperactive individuals would tend to perceive movement in ambiguous stimuli to a greater extent than would hyperactive individuals, and that the tendency to perceive movement in ambiguous stimuli would play a significant role in deter-

mining the critical flicker frequency and apparent movement thresholds of mentally retarded children.

However, predictions made on the basis of these hypotheses were not confirmed. Ratings of hyperactivity and measures of the tendency to perceive movement in ambiguous stimuli were not found to be significantly related to the perceptual threshold measures.

The consistently negative findings of the present investigation suggest the possibility that the intellectual inadequacy of retarded subjects, and their chronic insecurity in test situations, play decisive roles in determining their responses to the necessarily ambiguous perceptual threshold stimuli. Therefore, it appears that careful study of these perceptual threshold tasks as measures of individual differences with mentally retarded subjects is necessary before the thresholds derived from these measures can be accepted as valid indexes of neurophysiological functioning.

Microfilm \$2.10; Xerox \$7.40. 160 pages.

# THE VISUAL DISJUNCTIVE REACTION TIME OF NORMAL AND CHRONIC SCHIZOPHRENIC SUBJECTS UNDER VARIED PRESENTATIONS OF AN AVERSIVE SOUND STIMULUS

(L. C. Card No. Mic 58-2893)

Peter John Lang, Ph.D.  
The University of Buffalo, 1958

A number of theorists have suggested that the impairment of schizophrenics on psychomotor tests is attributable to lowered "motivation", attitudinal variables such as indifference to the task or uncooperativeness. Attempts have been made to test this hypothesis by introducing aversive stimuli into the experimental situation in ways designed to raise the motivational level of patients to perform. The present study was designed to examine this proposition for a disjunctive reaction time task, with special attention to the role played by the aversive stimulus in modifying the schizophrenic's response.

The subjects were 70 chronic schizophrenic patients and 50 "normal" subjects. They all received 63 trials on a task which involved the pressing of one of two telegraph keys, depending on which of two neon lights was illuminated. The first 21 trials (pre-stimulation) were conducted under the usual conditions of administration for reaction time tests. For the second 21 trials (stimulation), both diagnostic groups were divided randomly into five equal sub-groups. Depending on sub-group assignment, subjects performed during these trials under one of the following conditions:

Escape: An aversive stimulus ("white" noise) was presented to the subject through earphones simultaneously with the visual stimulus, and terminated by a correct response.

Excitation: The aversive "noise" was presented simultaneously with the visual stimulus and maintained for a duration independent of the subject's response.

Avoidance: The aversive "noise" was presented subsequent to the visual stimulus if the subject's response was "too slow" (defined by the subject's median latency on the previous seven trials).

Information: A non-aversive sound stimulus was

presented subsequent to a visual stimulus, following the same pattern as for the Avoidance group.

**Control:** No additional stimuli were introduced into the experimental situation.

The final 21 trials (post-stimulation) were conducted under the same conditions which had prevailed during pre-stimulation trials.

#### Results:

1. Under all conditions of the present experiment chronic schizophrenic subjects displayed significantly longer reaction time latencies than did "normal" subjects.

2. Under no experimental condition did "normal" subjects display a significantly greater decrement in reaction time than "normal" control subjects.

3. Under Escape conditions, schizophrenic subjects displayed a greater decrement in reaction time from pre-stimulation to stimulation trials than did schizophrenic Control subjects.

4. The decrement in reaction time of schizophrenic subjects performing under Excitation conditions was not significantly different from Control subjects, nor was it significantly different from that of members of the Escape group.

5. The decrement in reaction time of subjects performing under avoidance conditions was not significantly different from that of the information group.

6. Subjects performing under Information conditions displayed significantly greater decrement scores than control subjects on both stimulation and post-stimulation trials. None of the other groups displayed significantly greater decrement scores than Control subjects on post-stimulation trials.

7. Schizophrenic subjects displayed significantly greater decrement scores than "normal" subjects under the Excitation condition.

8. "Normal" Control subjects displayed significantly greater reaction time decrement from pre-stimulation to stimulation trials than did schizophrenic Control subjects.

The results were interpreted as suggesting that factors such as cooperativeness and attitude towards the task were of minimal importance in accounting for the reaction time "deficit" of chronic schizophrenics. An explanation of the improvement of schizophrenic subjects under aversive stimulus conditions was offered in terms of the dynamogenic properties of an intense stimulus, rather than the reinforcing effects of "escape." It was suggested that the reaction time "deficit" of these subjects could be best understood as an impairment of "set." It was proposed that aversive stimuli be introduced in the study of the schizophrenic's performance on a variety of tasks, as a method of distinguishing between those tasks which represent more fundamental symptoms and those which reflect secondary or more transitory impairment.

Microfilm \$2.00; Xerox \$4.40. 83 pages.

#### THE EFFECTS OF DIFFERENTIAL VERBAL REINFORCEMENT ON PSYCHIATRIC AND NON-PSYCHIATRIC HOSPITAL PATIENTS

(L. C. Card No. Mic 58-2973)

Allan M. Leventhal, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Leonard D. Goodstein

The importance of understanding human learning based upon social motivation has led, in recent years, to an increased attention to learning without awareness as one approach to studying this problem. Although many studies have varied the nature of the reinforcing agent used to induce this learning or the characteristics of the subject population involved, a careful investigation which simultaneously varies aspects of both dimensions has not been attempted to date.

The present study investigated the reinforcing values of specific verbal stimuli denoting approval and disapproval when used with various diagnostic groups. Sixty schizophrenics, sixty non-psychotic psychiatric patients, and sixty ambulatory patients from a general medical hospital population who were presumably normal comprised the three experimental groups. Ss were presented with eighty 3 x 5 cards, each of which contained the same four pronouns (I, We, He, They), but a different verb in the past tense and instructed to make up a sentence containing the verb indicated on the card and beginning with one of the pronouns. These eighty trials were arbitrarily broken down into four blocks of twenty trials each and the number of times a S began a sentence with a first person pronoun within each of these blocks was used as the criterion measure. The basal level of such usage was established by the first block during which E made no response to the S. Within each diagnostic population each S was randomly assigned to one of four treatment groups to which E responded differentially from the 21st through the 80th card presentation:

(a) To the reward group, E responded with "good" immediately following any sentence which began with a first person pronoun, but made no response following any sentence beginning with a third person pronoun.

(b) To the punishment group, E responded with "not so good" immediately following any sentence beginning with a third person pronoun, but made no response following any sentence beginning with a first person pronoun.

(c) To the reward and punishment group, E responded with "good" immediately following any sentence which began with a first person pronoun and "not so good" following any sentence which began with a third person pronoun.

(d) To the control group, E made no comment at all during the experiment.

In addition, all Ss were carefully questioned at the conclusion of the session to determine whether they could verbalize any relationship between the E's behavior and their performance.

Results of the study were evaluated by means of analysis of variance techniques. A significant over-all triple interaction between trials, treatments, and diagnoses suggested that the effects of each of these variables was dependent upon each of the other variables. Analysis of the simple effects and the lower-order interactions for the normal Ss showed highly significant learning over trials,

with E's use of reward, punishment, or both being equally effective. Neurotics, however, clearly learned only under the combined use of reward and punishment and reward alone. Thus, while reward and punishment led to clear-cut learning with the normal Ss, the usefulness of reward with schizophrenics and punishment with neurotics was ambiguous.

In addition, perusal of the results for the four treatment groups disclosed significant differences among diagnoses only in the reward group, where the normals clearly out-performed the schizophrenics.

A classification of the statements offered by the Ss to explain what they considered to be the intent of the experiment indicated that the present results could not be readily explained in terms of S's use of correlated hypotheses.

Microfilm \$2.00; Xerox \$3.60. 64 pages.

# THE EFFECT OF TRANQUILIZING DRUGS ON CONDITIONING RATE OF GSR IN A GROUP OF PSYCHIATRIC PATIENTS

(L. C. Card No. Mic 58-2817)

Lonnie Edward Mitchell, Ph.D.  
The American University, 1958

The purpose of this research was to study the effects of tranquilizing therapy on GSR conditioning rate in a group of psychiatric patients. The problems of the research were concerned with 1) the effects of tranquilizing therapy on classical avoidance conditioning in psychiatric Ss, 2) the factor of anxiety and its relation to other personality variables, 3) the relationship of GSR conditioning to anxiety, and 4) a test of Pavlov's hypothesis of excitation-inhibition.

The study was carried out upon 69 psychiatric Ss who met selection criteria of: a) new admission, b) no previous drugs, c) age limit of 15 to 60 years, d) no organic disturbance, e) no mental defectives, f) ability to adjust in conditioning setting, g) Ss free from physical treatments such as insulin, EST, sodium amytal, etc., of at least 30 days. Experimental and control groups were formed to which the Ss were assigned in accordance with assignment criteria of rating on the behavior rating scale of anxiety, age, sex, and diagnosis. Personality questionnaires (Taylor MAS, Winne Scale of Neuroticism, Guilford Factors STDCR, Guilford-Martin Factor N) were administered pre- and post-therapy for the purpose of ascertaining a measure of manifest anxiety. GSR conditioning was performed pre- and post-therapy with a Psychogalvanic Response Unit in series with a Multi-Channel Recorder, the Maico Model H-1 Audiometer, and a memory drum.

The hypotheses to be tested were: 1. High anxiety Ss as measured by psychological tests condition more readily prior to drug therapy than do low anxiety Ss, regardless of diagnosis; 2. After drug therapy, high anxiety Ss manifest a significantly greater decrease than do low anxiety Ss, regardless of diagnosis; 3. After drug therapy anxiety scores of high anxiety Ss show a significantly greater decrease than to low anxiety Ss, regardless of diagnosis; 4. There is no significant difference in conditioning rate of the low anxiety Ss as a result of drug therapy.

The results and conclusions of the research are as

follows: Thorazine therapy has a statistically significant effect on GSR acquisition rate in a group of psychiatric patients. There was no net significant difference or change in the extinction rate of the Ss tested. Anxiety level remained relatively stable among those Ss who did not receive medication. There was a highly significant difference and net change in GSR acquisition rate among schizophrenic Ss as a result of thorazine therapy. A highly statistically significant difference in GSR acquisition rate was reflected between male and female Ss prior to therapy, following therapy, and in net change differences. There was a highly statistically significant difference in the basic skin resistance of Ss before therapy and after therapy. High anxiety patients, as measured by psychological tests conditioned more readily prior to drug therapy than did low anxiety patients. After drug therapy high anxiety Ss manifested a significantly greater decrease in conditioning level than did low anxiety Ss. There were highly significant differences in high and low anxiety subjects' scores after therapy. Thorazine has a statistically significant effect on conditioning rate of low anxiety Ss and little effect on low anxiety subjects' response to personality questionnaires. There was a minor effect of Thorazine upon the Taylor MAS, however, the male group showed a significant change in response. There was a significant relationship reflected between the Winne Scale and GSR acquisition response, the Taylor male score and GSR acquisition, the Taylor and schizophrenics and GSR, the Winne male schizophrenics and GSR acquisition. The introversion-extroversion factors showed no change as a result of 30 days of therapy. The social introversion-extroversion factors showed no change as a result of therapy. Overall, the ratings of the Behavior Rating Scale of Anxiety showed no significant relationship to GSR acquisition, to cycloid disposition, to depression, to neuroticism as measured by factor N, though the direction of the difference was positive. Psychiatrists evaluated female Ss as significantly less anxious after drug therapy.

Microfilm \$2.60; Xerox \$9.00. 199 pages.

# MALE HUMAN FIGURE DRAWING IN NORMAL AND EMOTIONALLY DISTURBED CHILDREN

(L. C. Card No. Mic 58-3789)

John Armstrong Popplestone, Ph.D.  
Washington University, 1958

Chairman: Winifred K. Magdsick

The problem of the present research was to determine whether or not there was a parallel between the drawings and the clinical behavior of children. In order to test this parallel the following three hypotheses were formulated:

- I. Emotionally disturbed children draw more like children who are younger than like their chronological peers.
- II. Emotionally disturbed children, as a group, exhibit more variability than do normal children of the same age level.
- III. Emotionally disturbed children include in drawings aspects that are infrequent in the drawings of normal children.

Each of these hypotheses was tested by comparing the drawings of a man obtained from a sample of 363 public school children, aged seven through ten years, with those obtained from a sample of 67 children, aged nine and ten years, who had been referred to a child guidance bureau. The school children were assumed to be normal if they were regular attendants at school, had no known history of emotional or physical deviation, and were not observed to display any gross emotional problems. Emotional disturbance was established not only by the referral to the child guidance agency but by the staff's diagnosis of emotional problems. Except for the division in clinical status the two samples were equated in other variables as rigidly as present procedures in clinical psychology permit.

The drawings were analyzed in terms of 120 specific items derived from previous research and included both Goodenough items and ones secured from studies concerned with the indices of emotional problems in drawings. The first task in analyzing the data was one of identifying age differences and comparing the level of functioning of the normal and clinical children on those items which revealed an age progression. The next step was a comparison of the two groups in variability. The third involved an analysis of those aspects of the drawings which were unique to the clinical sample. The statistical criteria of significance of differences were rigid and cross validated. Within the limits of these samples and these procedures the following conclusions were reached:

1. Immaturity is manifest in the drawings of emotionally disturbed children and although such behavior is not pervasive, it is more apt to be present than absent in those items that are related to age progressions.
2. There is probably no difference between normal and emotionally disturbed children in the variability of either total Goodenough scores or the size of the drawings. These aspects of the drawings were the only ones that permitted measurement of sample variability and nothing can be said about this trait in the other aspects of the drawings.
3. Emotionally disturbed children tend, with disregard of the instructions, to draw a woman or a distanciated figure and to add extraneous marks to their figures more frequently than do normal subjects. These additions may be called original in the sense in which it was defined in the paper.

These conclusions point to the value of extended investigations of drawings on an individual as well as an actuarial basis. The process of obtaining these conclusions indicated the need of research in areas not central to the current problem but involving such factors as characteristics of the subjects, the conditions under which the drawings are secured, and the reliability and validity of the drawings themselves. Microfilm \$2.10; Xerox \$7.40. 158 pages.

## PSYCHOLOGY, EXPERIMENTAL

### AN EMPIRICAL STUDY OF THE MEASUREMENT OF PSYCHOLOGICAL DISTANCE

(L. C. Card No. Mic 58-3634)

David Cromwell Beardslee, Ph.D.  
University of Michigan, 1958

Several methods for measuring psychological magnitudes were empirically compared. The stimuli chosen were spatial intervals bounded by two short vertical lines. Repeated judgments of the relative size of simultaneously presented pairs of such stimuli were obtained and the inconsistency of choice analyzed to yield an inferred psychological scale in which psychological magnitudes are based on ease of discrimination.

Judgments were also obtained of the relative similarity of two such stimuli to a third by the Method of Propellers or of three to a fourth by the Method of Y-Cartwheels. These judgments were analyzed for a psychological scale based on discriminability. In addition, the median judgments derived from the combined propeller and cartwheel data were utilized as data for analysis by the Unfolding Technique.

Two experiments were carried out. Each involved one subject who made judgments in all three ways for a total of at least one hundred hours.

For both pair judgments of stimuli and judgments of similarity a variety of constant errors of judgment due to temporal, spatial-positional, and similar factors were noted, although none contributed a very large percentage of the total information in the data except for systematic changes of one subject's similarity judgments. In many cases the two subjects displayed different effects, or one subject showed an error and the other did not.

For all three kinds of judgments and the scales inferred therefrom, some psychological magnitudes were different for the two subjects. Their data were therefore not combined.

There were no significant differences between data obtained by the propeller and the Y-cartwheel methods; or between Y-cartwheels differing in one stimulus. Since the amount of data collected here was large, it may be assumed that in more usual studies involving smaller quantities of data, such differences as might exist would be negligible relative to errors of measurement.

The agreement of the inferred psychological magnitudes on the psychological scale derived from the inconsistency of pair judgments with the scale derived by analogous procedures from inconsistency of judgments of similarity was found to be of the same order as the reliability of the scales.

Successive comparisons of the psychological magnitudes derived by the unfolding technique with the other scales showed that the psychological magnitudes composing the unfolding scale disagreed with the others in only two to four per cent of the psychological magnitudes. However, for at least one subject, the scales were not identical. This lack of identity was not attributable to unreliability.

One subject's judgments changed with time in such a manner as to alter the unfolding scale but not others. The other subject displayed significantly different temporal trends in judgment by different methods of collecting data,

implying oppositely directed changes in the units of measurement on the scales derived from such data.

The use of the untransformed percentages of inconsistency, in either pair judgments or judgments of similarity, involved additional disagreement of psychological magnitudes, and appears to be less desirable as a means of ordering psychological magnitudes by size.

It was concluded that although the methods of measuring psychological magnitudes studied yielded much the same information, the results were definitely not identical, either for two subjects or for two methods within a single subject. Microfilm \$4.45; Xerox \$15.00. 346 pages.

#### EFFECT OF VARIATION IN DISTANCE CUES ON THE PERCEPTION OF OBJECT SIZE

(L. C. Card No. Mic 58-3034)

Harold Paul Bishop, Ph.D.  
State College of Washington, 1958

An experiment was conducted to determine the effects of standard size, luminance, and distance upon apparent size under conditions of reduced distance cues. Standards were observed binocularly or monocularly by subjects with or without pre-knowledge of the experimental conditions.

Observations were made of circular standards subtending a constant visual angle of  $1^\circ$  at 10, 20, 25, 30, 45, 50, 55, and 60 feet, and with standards of 2.1, 5.3, 10.5, and 14.7 inches diameter at each of these distances. Standard luminances were 3, 1, 0.1, and 0.01 foot-lamberts.

The comparator, 10 feet distant and  $90^\circ$  to the left of the subject's line of regard to the standards was always observed binocularly. Comparator luminance was held constant at 1 foot-lambert.

An incomplete mixed factorial design was used with 14 independent groups of 5 subjects each, observing under conditions determined by combinations of the knowledge, method of regard, and luminance variables. Combinations involving the 3 foot-lambert luminance were used only with the no-pre-knowledge groups. All subjects, naive, male college students with normal visual acuity, made observations with all combinations of standards and distances.

Raw data showed extreme heteroscedasticity and correlations of means and variances which could not be rectified through transformations of the data. For statistical analysis a non-parametric analysis of variance technique was utilized. Trend analysis was accomplished by use of Friedman's  $X^2_r$  technique with interactions calculated according to Wilcoxon. Curves were fitted, and empirical functions determined for the plots of median apparent size as a function of distance.

The results of the experiment indicate that:

1. The variables; standard size, luminance, distance, method of regard, and state of knowledge of the experimental conditions are all significant determiners of apparent size.
2. These variables interact to a significant degree and few generalizations may be made concerning the effects of one variable out of the context of the complex of variables defining the observational conditions.
3. The use of the combination of instructions stressing an analytic set and a reduction tunnel results in a low degree of size constancy.

4. Neither slope of the curve of apparent size as a function of distance nor absolute magnitude of apparent size is an entirely adequate criterion of degree of constancy.

5. Less constancy is shown with monocular regard as compared with binocular regard.

6. With binocular regard, size constancy, by a slope criterion, decreases to a limited and irregular extent, while the absolute magnitude of apparent size tends to increase, as standard luminance is decreased.

7. With monocular regard both absolute magnitude of apparent size and size constancy, by a slope criterion, decrease as standard luminance is decreased.

8. Larger standards at close distances are perceived most veridically.

9. As standard size is decreased there is an increasing "overestimation" of standard size.

10. This "overestimation" increases with binocular regard and decreases with monocular regard as standard luminance is decreased.

11. The primary effect of pre-knowledge of experimental conditions is an exaggeration of "overestimation."

12. By a slope criterion, size constancy decreases as standard size is decreased.

13. There is little or no over-all difference between results obtained with constant size standards and transformed to equivalent constant angle form and results obtained with constant angle standards. The results are not strictly interchangeable, however, and results obtained under a particular combination of observational conditions may differ slightly as a function of the type of standard used. Microfilm \$2.00; Xerox \$5.40. 109 pages.

#### SPECTRAL THRESHOLDS IN THE STARLING (STURNUS VULGARIS)

(L. C. Card No. Mic 58-3218)

John I. Dalland, Ph.D.  
Columbia University, 1958

It is generally assumed that diurnal birds possess both color vision and a duplex retina. Thus it might be expected that the starling would display a characteristic Purkinje shift in its spectral threshold functions.

The present investigation obtained data showing log relative absolute threshold energy as a function of wavelength. The spectral thresholds for four starlings were obtained utilizing a slightly modified version of the free operant key-pecking technique developed by Ratliff & Blough, in which the bird directly controls the stimulus intensity and is reinforced in such a way as to restrict the stimulus to a narrow set of values oscillating around its threshold.

Dark adaptation curves were first obtained in response to stimulation by monochromatic light of twenty different wavelengths between 400 and 700 mμ. Two conditions of pre-adaptation were used: 55 minutes of pre-dark adaptation followed by ten minutes light adaptation of a maximum luminance of 2360 millilamberts of white light; or 55 minutes of pre-dark adaptation only.

The asymptotic threshold values resulting from the conditions of pre-light adaptation and no pre-light adaptation, defined respectively, the photopic and scotopic thresholds for any given wavelength.

The principal results are summarized below:

1. The starling dark adaptation curve seemed to be profoundly affected by pre-light adaptation. No rod-cone break was observed even after sixty minutes in the dark, following light adaptation. It is postulated that this is more a function of pigment migration than of rod photochemical regeneration.
2. The spectral photopic threshold function of the starling was found to be very similar in shape to that of the aphakic human. Both display greater sensitivity to violet and blue light, than would be expected for a normal human eye containing a yellow filtering lens.
3. The minimum of the starling photopic curve appears to be shifted about 20 mu toward the lower wavelengths from that of the pigeon. A possible explanation lies in the absence of orange oil droplets in the cones of the starling.
4. The starling photochromatic interval shows a minimum at about 640 mu. Above and below this wavelength, the cone and rod functions diverge. Evidence relative to this is presented.
5. The dark adapted starling eye appears relatively less sensitive to monochromatic light of almost all wavelengths than the dark adapted eye of the pigeon. This relationship appears to reverse itself, however, for the longer, red wavelengths. Microfilm \$2.00; Xerox \$3.00. 45 pages.

#### THE EFFECT OF SUCCESSIVE ACQUISITIONS AND EXTINCTIONS ON OPERANT DISCRIMINATION LEARNING IN FISH

(L. C. Card No. Mic 58-2023)

William Alexander Deterline, Ph.D.  
University of Pittsburgh, 1958

There is a considerable body of experimental literature that indicates that experience with nonreinforcement is as important an event in the determination of later behavior as is reinforcement. Transfer of training occurs following learning in one situation, to learning in a new situation. Both the acquisition and extinction phases of learning provide the basis for this transfer.

One type of experiment in which this progressive transfer is observed is the alternation of periods of reinforcement and nonreinforcement. Successive extinctions occur more rapidly and response rate during periods of reinforcement shows a progressive increase to asymptote. One explanation offered for this progressive change is that the subjects learn to discriminate between conditions of reinforcement and nonreinforcement. This hypothesis has also been offered in slightly different form to account for the formation of learning sets and for the progressive increase in efficiency in successive discrimination reversals.

The first phase of the present study consisted of successive alternations of periods of acquisition and extinction of a free operant—target pressing—in fish, to investigate the course of the increasing acquisition and extinction rates in this organism, if such changes appeared.

The second phase consisted of an operant discrimination in which responses in the presence of a 'bright' light

were reinforced, and responses in the presence of a 'dim' light went unreinforced. It was predicted that previous experience with extinction during phase one would have a facilitating effect on discrimination learning, since extinction in the presence of the negative stimulus was the basis for the discriminatory responding.

#### Subjects and procedure

Twenty Cichlid fish, *Tilapia macrocephala*, were divided into four groups of five. Subjects were used daily when deprived of food for 24 hours. All were trained through successive approximations to press a target. Reinforcement consisted of a few grains of powdered food dropped by an automatic device onto the surface of the water.

In most cases, from two to three weeks of successive approximation training were necessary before the first target press occurred. During phase one, groups I, II, and III received, respectively, 20, 40, and 60 reinforcements per day for 15 consecutive days. Following the final reinforcement, all subjects in these groups were extinguished for one hour each day. Group IV was a control group that received 40 reinforcements per day as did group II, but group IV was given no periods of extinction.

Following the fifteenth day of phase one, phase two was begun. During this phase, all four groups received identical treatments. A single response to the positive stimulus was reinforced, following which the negative stimulus was present until 28 consecutive seconds elapsed without a response occurring. The positive stimulus was then again presented and the procedure continued for one hour per day for five days.

During phase one, all groups showed a significant decrease in time required to make the appropriate number of reinforced responses, reaching asymptote by about the eighth day. Groups I and II showed an initial increase in resistance to extinction up to about the fifth day, followed by a gradual decline to about the thirteenth day. Satiation effects were apparent during reinforcement in group III, which showed no progressive change.

On the first day of phase two, group IV subjects made significantly more responses in the presence of the negative stimulus than did any of the other groups. Groups II and III received more reinforcements on the first day than did groups I and IV, although the differences were of borderline significance. The group differences disappeared during the following days.

It was concluded that this class of subjects showed an increase in speed of discriminating conditions of non-reinforcement from conditions of reinforcement and that this discrimination was the basis for the group differences in operant discrimination in phase two.

Microfilm \$2.00; Xerox \$5.40. 108 pages.

#### PROBLEM SOLVING AND MOTOR SKILL BEHAVIORS UNDER CONDITIONS OF FREE-CHOICE

(L. C. Card No. Mic 58-3655)

Robert William Earl, Ph.D.  
University of Michigan, 1958

The general problem under study is to discover the basic factors that control attention; i.e., to explain how and

why individuals respond to selected portions of the environment. Fundamentally the problem reduces to the problem of predicting choice behavior. The latter problem is the subject of the present investigation. This thesis presents a theory of choice and employs individuals' evaluations of stimuli in conjunction with the theory to predict sequences of choices among the stimuli.

Each of 17 children, ages 10-15 years, performed in two experiments. In Experiment 1 the subjects (a) constructed several different block-design puzzles and (b) judged the similarities among the puzzles in terms of the "amount of figuring," in one case, and "amount of fun" involved in working the puzzles, in another. In Experiment 2 the subjects (a) threw darts from three different distances from the target and (b) judged the similarities among these distances in terms of the "amount of skill," in one case, and "amount of fun" involved in throwing the darts, in the other.

If a subject's judgments of "amount of figuring" in Experiment 1 were found to be consistent and transitive, the hypothesis was accepted that (a) the stimuli (i.e., the puzzles) lay on a unidimensional attribute in terms of their measures of complexity and (b) the greater the judged "amount of figuring," the greater the complexity of the stimulus being judged for the individual and trial in question. The same hypothesis was tested for the stimuli (i.e., the distances) in Experiment 2 using the "skill" judgments. The complexities determined by the "figuring" or "skill" judgments differed of course for different subjects and also changed with time.

The "amount of fun" judgments from each experiment were also tested for consistency and transitivity to see whether they yielded a preferabilities continuum. If these conditions were satisfied, the subject's complexity for the attribute and trial in question was defined as the complexity of the preferred stimulus. This definition assumed that in each experiment (a) both the complexity and preferability judgments were mediated by a single underlying attribute and (b) the subject's complexity on the given attribute was the measure that perfectly represented his momentary capability in terms of his own evaluation of himself.

The results are as follows: (a) the preferabilities continuum obtained from the analysis of the preference judgments for a given subject is found to correspond to the attribute obtained from the "figuring" or "skill" judgments folded at the preferred stimulus, (b) the experimentally naive subjects respond initially to the simplest stimulus and proceed through the remaining stimuli in order of increasing complexity, (c) each subject apportions his responding among the stimuli (in terms of time spent or frequency) in inverse proportion to the differences between the complexities of the stimuli and his complexity plus some increment, and (d) if a subject shifts his preference (i.e., changes in complexity), the shift is unidirectional towards more complex measures on the attribute.

These results show that under certain conditions an individual's attribute structure defined for a given trial is systematically related to some of the characteristics of his "free-choice" behavior for the stimulus situation and trial in question. The theoretical interpretation of these results is that an individual's attention is aroused by the discrepancies between the momentary complexities of the available stimuli and his own momentary complexity for the attribute in question.

Microfilm \$2.70; Xerox \$9.40. 208 pages.

## STIMULUS SIMILARITY AND TEMPORAL FACTORS IN VERBAL TRANSFER OF TRAINING

(L. C. Card No. Mic 58-3784)

Henry Carlton Ellis, Ph.D.  
Washington University, 1958

Chairman: James M. Vanderplas

The purpose of this study was to investigate the effects of stimulus similarity and the temporal interval between first and second task learning on verbal transfer of training. In addition, an examination of some methodological aspects of the measurement of transfer was made. The study was designed to give information relevant to theoretical models of transfer of training such as the Osgood transfer surface and to aid in distinguishing the processes of transfer, retention and generalization.

All experimental Ss learned the same initial list of eight pairs of adjectives by the method of paired associates. Lists were presented on a Missouri-type drum under massed practice. The criterion of learning was two perfect consecutive anticipations of the list.

After learning the first list Ss were randomly assigned to one of 12 experimental subgroups and were required to learn a second list of eight paired adjectives. The experimental Ss were assigned to one of three conditions of stimulus similarity, defined by employing Haagen's scale of meaningful similarity, and one of four conditions of time between the learning of the first and second lists. In summary, the experiment was a 3 x 4 factorial design with Ss randomized.

Several measures of transfer were examined in order to determine if the effects of stimulus similarity and time were dependent upon the criterion measure employed. Both trials to criterion and the number of correct responses made on the first anticipation trial of the second list were employed. In addition, regression equations were fitted to the data in order to provide a measure of the intercept and slope constants of the learning curves. Transfer was then analyzed in terms of these two measures.

An analysis of variance of transfer in terms of trials to criterion showed that neither similarity, time nor interaction was statistically significant.

An analysis of variance of transfer in terms of the intercept showed that only the time variable was statistically significant.

An analysis of variance of transfer in terms of the slope constant showed that time and the TxS interaction were significant. When the variance estimates were adjusted by the application of an analysis of covariance which controlled for trials to criterion on the first task, similarity emerged as a significant variable.

The following conclusions were drawn:

1) Transfer when measured by trials to criterion is not differentially facilitated by stimulus similarity. No reliable variation in transfer as a function of time exists using this measure, and no significant interaction between time and similarity was found.

2) Transfer when measured by the number of correct responses was differentially facilitated by stimulus similarity. No reliable variation in transfer as a function of time exists employing this measure.

3) Transfer of training measured in terms of the intercept is not differentially facilitated by stimulus similarity; however, transfer declines as a function of time.

4) Transfer of training measured in terms of the rate of learning is dependent upon stimulus similarity; this is clear only when the transfer measure has been controlled for by trials to criterion on the first task. Transfer increases as a function of time when this measure is employed.

5) The results point out, more generally, that the effects of stimulus similarity on verbal transfer depend, at least partly, upon the criterion of transfer and the type of statistical controls employed. In the same fashion, the effects of the time variable are in part dependent upon the criterion of transfer unemployed.

Microfilm \$2.00; Xerox \$6.20. 129 pages.

#### EXAMINATION OF DISCRIMINATION LEARNING BEHAVIOR IN THE RAT USING OLFACTORY CUES

(L. C. Card No. Mic 58-3040)

George Horton Foster, Ph.D.  
State College of Washington, 1958

This exploratory investigation was conducted for the purpose of examining the technique of using olfactory cues in discrimination experiments and as an analysis of discrimination learning throughout a series of problems utilizing the same subjects. Attention was given to relationships between learning proficiency and (1) intrinsic characteristics of odor cues, (2) spatial response preferences, (3) approach and avoidance tendencies, and (4) nature of errors. Both visual and olfactory discrimination problems could be provided by the apparatus. Three phases of experimentation were organized.

In Phase I the responses of sixty-five albino rats were analyzed in terms of position habits during a free situation in which responses could be either visual or spatial. Following this the animals learned a visual discrimination problem.

In Phase II surviving animals learned olfactory discrimination problems in which solutions of methyl salicylate, butyric acid, and fish oil served as stimuli.

In Phase III the animals learned a new olfactory discrimination problem after having been divided into two matched groups, approach and avoidance. Approach animals learned an approach response to their previously negative olfactory cues and avoidance animals learned an avoidance response to their previously positive olfactory cues.

Results and conclusions were organized in terms of the four areas of relationship mentioned above.

##### Intrinsic characteristics of odor cues

1. Stable discrimination responses to olfactory cues are easily developed in the rat. However, large individual differences exist both in speed of learning and in stability of response.

2. Different odor cues have markedly different effects on learning as measured by performance. At the concentrations used methyl salicylate and butyric acid facilitated learning when negative and hindered learning when positive. The effect was most pronounced in the case of methyl salicylate.

3. Variations in avoidance behavior suggest that the degree of pleasantness or unpleasantness of an odor in terms of human evaluation is not paralleled in the rat.

##### Spatial response preferences

1. In both visual and olfactory discrimination problems, position habits are retained throughout learning as mediating the initial segment of the response sequence.

2. Position habits tend to become stronger and stronger to the extent that the initial segment of the total response sequence becomes more and more consistently left or right.

3. Stability of position habit is related to the odor cue, as well as whether it is positive or negative. Methyl salicylate emerged as most significant.

4. In a free situation most animals respond consistently in terms of some cue preference, with the relationship between consistency and proportion of animals appearing roughly rectilinear. However, many animals show one or more shifts in preference.

##### Approach and avoidance tendencies

1. Avoidance tendencies among odor cues vary. At the percentage concentrations used in this experiment methyl salicylate elicits the greatest avoidance and fish oil the least.

2. Avoidance tendency is probably a function of odor intensity.

3. Within a group of albino rats, the magnitude of an avoidance tendency toward a specific olfactory cue is extremely variable.

##### Nature of errors

1. In discrimination learning two types of errors may be committed. Approach errors are failures to respond to the positive cue and avoidance errors are failures to respond to the negative cue. Avoidance errors are a function of the animal responding to irrelevant cues such as those mediating position habits.

2. Approach errors are associated with avoidance tendencies. Greater frequencies were associated with methyl salicylate as a positive cue.

3. The phenomenon, vicarious trial and error, can be given meaning and quantification by reference to the concept of approach error.

Microfilm \$2.00; Xerox \$3.80. 67 pages.

#### RETINAL RIVALRY: ITS RELATION TO READING DISABILITY, EYE MOVEMENTS IN READING, OCULAR DOMINANCE, AND VISUAL ACUITY

(L. C. Card No. Mic 58-2667)

Herbert R. Storch, Ph.D.  
Yeshiva University, 1957

The Problem: The major purpose of this study was to ascertain whether retinal rivalry was a factor in reading disability. The sub-problems of this investigation were: to investigate the relation between retinal rivalry, per se,

and reading disability; to determine whether any relation existed between retinal rivalry and eye-dominance; to discover whether any relation existed between retinal rivalry and visual acuity; and to evaluate a new technique for the investigation of ocular tendencies in reading.

**Methods of Procedure:** The Chicago Non Verbal Examination and the Stanford Achievement Test were administered to approximately seven hundred elementary school students in grades four to eight. On the basis of the results of these tests, ninety-eight Experimental subjects and ninety-nine Controls were selected. The Experimental group consisted of children who possessed average general intelligence, as indicated by a score of 90 to 110 on the non-verbal test of intelligence, and who were at least one year retarded in reading in reference to mental age. The Control group consisted of children within the same range of general intelligence and who were reading at or above the level of expectancy in reference to mental age. The techniques employed to investigate the visual characteristics of this population consisted of the Tests of Usable Vision of the Keystone Visual Survey Service, the monocular and binocular tests of the Harris Tests of Lateral Dominance, and the Digit and Letter tests which employ the retinal rivalry principle. These tests were administered to all subjects in the same sequence and with the same directions. To determine the reliability of the retinal rivalry tests, two trials were given on each. The Letter test was administered approximately one month after the Digit test.

**Sources of Data:** In order to determine visual acuity, the Tests of Usable Vision of the Keystone Visual Survey Service were used. An estimate of visual acuity was obtained for each eye individually and for both eyes together. Eye-dominance tendencies were determined by the monocular and binocular tests of the Harris Tests of Lateral Dominance. To ascertain retinal rivalry characteristics, the Digit and Letter tests devised for this study were used.

**Summary of Findings:** There were no statistically significant differences in the extent of retinal rivalry between the groups studied. Whereas the Experimental group showed a decided tendency towards regressive eye movements, the perception of ambiguous figures, and the omission and addition of characters as the eyes alternated in perception during retinal rivalry, the Control group did not. The observed differences were statistically significant. There was no significant difference in the percentage of eye-dominance for each eye between groups as revealed by the Harris Tests of Lateral Dominance. Whereas approximately seventy-five percent of the population showed definite eye preference on the Harris tests, the majority showed no decided eye preference on the retinal rivalry tests. Eye preference showed little relation to visual acuity. The retinal rivalry tests demonstrated a high degree of reliability. The test-retest coefficients of reliability for the Digit test were .920 for the Experimental group and .887 for the Control group. On the Letter test, the coefficients were .930 for the Experimental group and .823 for the Controls.

**Conclusions:** 1. Retinal rivalry, *per se*, is not a factor in reading disability.

2. As the eyes alternate in perception during retinal rivalry certain visual anomalies occur in some

subjects. Among these are regressive eye movements, the perception of ambiguous figures, and the omission and addition of characters. These tendencies are displayed more frequently by retarded readers.

3. Eye-dominance as indicated by unilateral sighting tests bears little relation to eye-dominance as determined by the retinal rivalry tests which represent a binocular reading situation.

4. No definite eye-preference is manifested by the majority of the population when both eyes are tested simultaneously.

5. Eye preference shows little relation to visual acuity.

6. The retinal rivalry tests used in this investigation are reliable measuring instruments. There is also reason to believe that they are valid for the purpose used.

Microfilm \$2.00; Xerox \$6.00. 124 pages.

### THE ROLE OF ASSOCIATION VALUE AND EXPERIMENTALLY PRODUCED FAMILIARITY IN PAIRED ASSOCIATE LEARNING

(L. C. Card No. Mic 58-2896)

Robert Lewis Weiss, Ph.D.  
The University of Buffalo, 1958

The present study reflects a renewed interest in paired associate verbal learning, where meaningfulness of S and R terms is an important acquisition parameter. It has been suggested in the literature that meaningfulness facilitates paired associate learning because of the increased familiarity of meaningful material. There have been no experimental demonstrations of the presumed functional equivalence of the two concepts. The present study purported to demonstrate the basic equality of the assumptions involved in operational definitions of meaningfulness and familiarity, and how both concepts could be comprehended by a more general theory of S and R term differentiation.

The present theory of S-R differentiation employs the construct of identifying responses as the major factor in S differentiation, and integration of instrumental responses, as the major factor in R differentiation. Variations in the stability of identifying responses and integration of instrumental responses were discussed, and their predictive significance for paired associate learning was formalized within a transfer of training theory. The hypotheses were as follows:

1. If meaningfulness (level of association value of nonsense syllables) and experimentally produced familiarity are functionally equivalent for S-R differentiation, then paired associates will be learned equally fast when the terms are either (a) high association value syllables, or (b) low association value syllables which have been familiarized.

2. Predifferentiated R terms will facilitate learning to a significantly greater extent than predifferentiated S terms. (Predifferentiation was defined either as H syllables, or familiarized L syllables.)

3. Lists with predifferentiated R terms will be learned faster than lists where neither term had been predifferentiated.

4. The ease of learning hierarchy, demonstrated for meaningful and non-meaningful words, was hypothesized for paired associate lists of H and L syllables, i.e., H-H, L-H, H-L, L-L, in order of increasing difficulty.

The procedure was as follows:

1. Four basic paired associate nonsense syllable lists were formed from high and low extremes in Glaze association values. Each of the four lists was learned by a different control group. Their performance indicated: (a) whether association value was a parameter of paired associate learning, and (b) whether the effect of meaningfulness was greater in S or R positions.

2. Six different experimental groups learned the basic lists after S or R terms had been familiarized. For two, H syllables in either S or R positions had been familiarized; in four groups L syllables in S or R positions had been familiarized.

3. The familiarization procedure required training to criterion on syllable recognition and articulation training. University students were used.

4. Two major retention measures were employed: (a) recall of S terms following S-R learning, and (b) unaided recall of S and of R terms.

The major findings were:

1. The functional equivalence of H and familiarized L syllables was demonstrated; high association value (meaningfulness) may be, therefore, no more than familiarity. The ease of learning hierarchy was obtained.

2. Predifferentiation of R terms facilitated learning more than predifferentiation of S terms. (Familiarization was a successful experimental manipulation in its own right.)

3. The retention measures indicated that increased attention paid to S terms during S-R learning impedes such learning, and because of this, familiarization applied to S terms failed to facilitate forward learning.

4. A mirror-image relationship was demonstrated for S-R and R-S learning; only integration of the term to be recalled predicts success in either task.

Other results indicated how levels of response integration are variously reflected in the different aspects of the learning task, and how forward learning measures may fail to illuminate significant features of the learning process. Microfilm \$2.35; Xerox \$8.20. 178 pages.

## RELIGION

### REDEMPTION IN THE THOUGHT OF EMIL BRUNNER AND ALBERT CORNELIUS KNUDSON

(L. C. Card No. Mic 58-2754)

Isaac Rufus Clark, Th.D.  
Boston University School of Theology, 1958

Major Professor: Dr. S. Paul Schilling

The problem herein involves the distinction between, the merits and demerits of, and the justification for the positions of Emil Brunner and Albert Cornelius Knudson in regard to redemption.

In Brunner's view redemption is necessitated in that man has fallen from God's glory "given" in creation through disobedience to the Sovereign Lord by, in, and for whom all men are made. Redemption is made possible only in Jesus Christ whose existence as the God-Man mediates grace and truth, and whose death evokes penitence by which men are forgiven in that the cross reveals the love and righteousness of God and the tragedy of the human predicament. This revelation is verified by the Holy Spirit in the lives of believers who are both redeemed and redeeming agents in the world. Complete redemption involving a perfected divine-human encounter is accomplished by the final act of God in eternity.

In Knudson's view redemption is necessitated in that men fall short of God's glory "implied" in creation through failure to accomplish sonship, the intention of the Divine Person for them. Redemption is made possible by the revelation in Jesus Christ whose self-sacrificial life and death awakens in men a responding love by which they are

morally and spiritually transformed. Believers' faculties are energized by the Holy Spirit; they are thus enabled to grow to the full stature of manhood found in Jesus Christ, and are redemptive agents in the world.

Outstanding contributions in Brunner's view are his emphasis upon the divine holiness, his synthetic view of the atonement, and his idea of the dependent and corporate nature of humanity. Problems arise in his extreme emphasis upon the divine holiness, his view of the relation between the divine and human elements in Jesus' life, and his idea of the passive nature of man in the divine-human encounter.

Knudson's view is highly commendable in regard to his emphasis upon the divine goodness, his distinction between the origin and the destiny of man, and his view of the dynamic nature of religious faith. Problems arise through his failure to emphasize consistently the gravity of sin, to bring out more clearly the meaning of the divine response to redeemed persons, and to deal realistically with the problem concerning the ultimate fate of the wicked.

The two positions are seen to be justified in that their inadequacies, contributions, failures in emphasis, differences, and contemporary theological descriptions result respectively from the inability of thought to apprehend the object, natural predilection by which each mind is peculiarly adapted to understand more fully certain phases of divine truth, the richness of divine truth as over against the poverty of a single system of thought, the variegated types of religious experience which must be interpreted, and the same "substantial" meaning which lies behind the two theologians' contemporary descriptions and the ancient Biblical description.

Microfilm \$3.35; Xerox \$11.40. 257 pages.

**THE MINISTRY OF THE LAITY  
AND THE PEOPLE OF GOD**

(L. C. Card No. Mic 58-2755)

Robert C. Harder, Th.D.  
Boston University School of Theology, 1958

Major Professor: Dr. Walter G. Muelder

The problem of the dissertation is that of exploring the Biblical, theological, historical, and ethical significance of the ministry of the laity in relation to the people of God.

The term laity is used primarily in a sociological sense but throughout the development it is recognized that in Christian witness and responsibility the laity vary only in function from the 'church workers.' The expression "people of God" is used synonymously with Church to depict the corporate and communal nature which stems from Jewish-Christian heritage.

The historical section surveys the position of the laity from the period of the early Church to the fourth century. It moves from that point to the Reformation and a consideration of Luther and Calvin. The laity are then considered in light of the Industrial Revolution with concentration on John Wesley and the Wesleyan movement in England and the Social Gospel movement in the United States. The survey concludes with a consideration of material from the contemporary ecumenical movement.

The second part of the dissertation takes from the historical material theological principles for undergirding the laity in their witness in the world. The theological principles have meaning for the people of God, both clergy and laity. These ideas speak to the wholeness of the Christian life when understood as a total commitment to God which results in a four-fold witness of proclamation, fellowship, worship, and service. Viewed within the context of the people of God these theological principles point to the need for understanding the division between clergy and laity within the churches as functional in nature and not of a hierarchical nature.

After a presentation of theological principles undergirding the ministry of the laity in the world, follows a discussion of the work being done by the World Council of Churches (with special emphasis on the Department on the Laity), in furthering the importance of the laity, as one part of the people of God, in their witness to the world. This section concludes with a survey of representative types of lay-preparation in Western Europe and United States. The types represented are lay centers, theological training centers, and frontier parishes.

Following that comes a discussion of communication pointing to the need for clearly understanding what must be communicated. A section on the how of communication argues for a re-evaluation of present methods of communication between clergy and laity in order that each group might be more clearly understood by the other. The reconstruction concludes with remarks concerning the important role the laity play in making responsible work-a-day decisions and the need for their being theologically prepared to make these decisions. An idea for setting up neighborhood meetings in a local parish and two proposals for starting a lay center illustrate as the dissertation closes possible ways for the churches to equip the laity for their ministry in the world.

The over-arching principle is that the Protestant

churches should uphold the idea of one ministry of the people of God derived from Jesus Christ which is worked out in numerous ministries of a varying nature but of equal spiritual and social importance. In practice many of the churches treat the laity as "second-rate" members minimizing their important role in witness in the world. Therefore they need to become more theologically aware of the laity as one part of the people of God who fulfill their ministry in the work-a-day existence of human affairs. Microfilm \$5.05; Xerox \$17.00. 394 pages.

**CHARLES CHAUNCY AND THE GREAT  
AWAKENING IN NEW ENGLAND**

(L. C. Card No. Mic 58-2737)

Barney Lee Jones, Ph.D.  
Duke University, 1958

Supervisor: H. Shelton Smith

This study offers a biographical analysis of Charles Chauncy, pastor of First Church, Boston (1727-1787), and his critical role in the Great Awakening in New England. Since no biography has been published, a chronological survey of the life of Chauncy is undertaken to ascertain from a knowledge of his habitual character, behavior and thought the personal basis of his opposition to the "religion of the times." Next, an outline of the development and course of the revival (1734-1745) is traced, with particular attention to adverse evaluations by its principal critics.

The common judgment that Chauncy was the "Grand Opposer" of the Awakening is sustained, with substantial qualifications. While it is true that on a priori grounds he was offended by certain aspects of the revival movement, he did not appear against it publicly until (1) he had been forced to abandon his "neutral" posture by vicious attacks upon his person and ministry, and (2) the fundamental defects of the Awakening had been acknowledged and censured by its strongest supporters. When delivered, his animadversion was a virtual reiteration of earlier strictures published against the revival by other opposers and conceded, ultimately, in matters of detail, by nearly all leading "instruments" of the Awakening.

It is then argued that the wide assumption that Chauncy's opposition to the revival was a predicable consequence of his "Arminian" theology and a coldly rationalistic and dispassionate nature is largely the product of a caricature, though theological and temperamental (as well as psychological) considerations influenced his antagonism. Positively, he was profoundly interested in the definition and encouragement of a "genuine" work of God in the land." After this, his basic concern was over the professional and economic jeopardy of the "standing ministry" of the reformed churches in New England and with the vindication of traditional ministerial standards and ecclesiastical discipline and order upon which, in his judgment, the security and prosperity of the Church of Christ depended.

Microfilm \$6.90; Xerox \$24.20. 543 pages.

# A CRITICAL ANALYSIS OF PAUL TILLICH'S METHOD OF CORRELATION

(L. C. Card No. Mic 58-2739)

Thomas Anderson Langford, Ph.D.  
Duke University, 1958

Supervisor: Robert E. Cushman

The theological renaissance of our generation has not come about nor will it continue unchallenged. It is faced with the defiant assurance of contemporary man who demands of the prodigal an account of its right to enter the household of modernity. It must present its credentials, its grounds and its presuppositions. Paul Tillich's theology authenticates itself in terms of his "method of correlation." Accordingly, this method and its presuppositions are the subject of this dissertation.

By the "method of correlation" Tillich means the dialectical nature of theology, as he understands it. That is, the answers which Christian faith offers must be brought into meaningful relation with the questions which man asks about his existence. It is the ground on which the possibility of this correlation rests that we are attempting to make evident in this essay.

By analyzing the correlation of reason and revelation, the study points to the assumption of an analogia entis or the logos structure of reality which provides the foundation for Tillich's system. In this connection the two modes of knowledge which grow out of this presupposition, viz., the mystical a priori and symbolic knowledge, are discussed.

Further, it is pointed out that for Tillich the most basic starting point for his constructive theology is the doctrine of creation. This doctrine, which is the theological statement of the analogia entis, has several significant consequences for his positive construction. In the first place, it emphasizes the essential continuity between man and being-itself. In the second place, it provides the foundation upon which Tillich is able to determine the significance of Jesus as the Christ. In the third place, it provides the basis for understanding what is correlated in the event of revelation, namely, the essential nature of man and the power of being which expresses itself through the logos structures. This is to say, for Tillich theology is primarily concerned with the ontological ground which provides both the possibility for and the content of revelation. Thus, the analysis of both sides of the correlation is, ultimately, the investigation of the power of being which makes itself manifest in the logos structure of reality.

In his discussion of revelation, Tillich stresses both sides of the event. Accordingly, it is contended that this implies the constitutive nature of both the objective and subjective poles of revelation. Thus, a co-ordinate stress is placed on both that which is given and that which is received. And, what is of great significance is the emphasis which is given to the subject which receives the revelation. On this basis theology becomes the analysis of the self's experience of God. For this experience points to the ultimate ground of faith. Throughout the essay there is a comparison of Tillich's position with that of Friedrich Schleiermacher, and the concluding chapter is a comparison of Tillich's position with that of Karl Barth.

Microfilm \$3.75; Xerox \$12.60. 289 pages.

# A CRITICAL EXAMINATION OF THE REVISED STANDARD VERSION OF THE NEW TESTAMENT

(L. C. Card No. Mic 58-2740)

Neil Roland Lightfoot, Ph.D.  
Duke University, 1958

Supervisor: Kenneth W. Clark

Since its appearance in 1946, many people have raised questions about the Revised Standard Version of the New Testament. Many have favored the new translation, but others have vigorously opposed it. The purpose of this examination has been to evaluate critically the RSV New Testament in the light of recent Biblical scholarship. In this examination attention has been focused mainly on the manner in which the translators have dealt with their resultant Greek text.

The groundwork for this study is laid in the Introduction and Chapters I-II. Chapter I is entitled "The Making of the Version". This chapter presents a discussion of the RSV committee, its members and their work, together with a consideration of the need for a new revision. Generally speaking, there are three reasons for the presence of the RSV: (1) the many inadequacies of the King James Version (KJV), (2) the failure of later "authorized" translations to overcome these inadequacies, and (3) the discovery of new materials not available at the time of the American revision (ASV) of the KJV.

Chapter II, "The Heritage of the Version", considers the degree to which the RSV reflects previous translations. Although the RSV profits from private translations and at times adopts their phraseology, the RSV nevertheless is a genuine descendant of the KJV-ASV tradition. Its close similarity with the RSV as a true revision and not as an independent translation.

Chapters III-VIII and the Conclusion comprise the burden of the dissertation. Six standards are proposed in these chapters by which a translation can be judged as good or bad. In Chapter III, "The Textual Base of the RSV New Testament", the text-type of the new revision is examined. The RSV displays an eclectic text-base, wavering in its agreement with the Greek texts of Tischendorf, Westcott-Hort and Nestle. Yet its textual base is better supported than that of the earlier "authorized" versions.

Chapters IV-V concern accuracy of translation. Chapter IV, "Improvements of Translation", points out a number of passages in which the RSV has attained a high degree of precision in its rendering. Chapter V, "Inadequacies of Translation", notes some places where the RSV lacks the accuracy generally characteristic of its work.

Chapter VI is entitled "Idiomatic Translation". Here the RSV far surpasses the literalistic ASV. The RSV presents a translation that is true to the Greek idiom and yet is congruous with English idiom.

Chapter VII, "Clarity and Consistency" views two additional criteria by which a translation can be appraised. The RSV is especially clear at a number of points where the ASV's translation might easily be misconstrued. In its rendering of words, however, the RSV falls short of a measure of consistency desirable as an "authorized" version.

Chapter VIII is entitled "The Literary Form of the RSV New Testament". This chapter is divided into the following parts: external form of translation, "Biblical English",

internal form of translation and use in public worship. By its improvement of the mechanics of translation, its elimination of much of "Biblical English", and its refined English style, the RSV has made great strides in providing a translation that commends itself to the average reader. This, in turn, means that it is suitable for public worship.

In the Conclusion two other significant deductions are made. (1) No clear evidence of theological bias is manifested in the RSV. (2) The RSV is not less accurate because of its freer rendering of the Greek than that of the ASV. Indeed, a free translation is often essential in conveying accurately the Biblical message.

Microfilm \$3.10; Xerox \$10.60. 239 pages.

LOVE AND JUSTICE: A STUDY IN THE  
CHRISTIAN ETHICAL THEORY OF  
REINHOLD NIEBUHR

(L. C. Card No. Mic 58-2829)

Jack Warren Moore, Ph.D.  
Duke University, 1958

Supervisor: Waldo Beach

This study in Christian ethical theory aims at an understanding of the relationship of love and justice. Its focus is in the new Protestant ethics of Reinhold Niebuhr. The writings of Niebuhr are a fruitful place to examine this problem because love and justice stand close to the center of his social ethical theory. The problem appears today most acutely whenever the Christian relates faith to issues of social justice. The directives of love often appear to be in a perplexing paradoxical relation to the demands of justice.

The method followed is to present an objective analysis of Niebuhr's treatment of the problem against the twofold background of the liberal social gospel ethic with Walter Rauschenbusch as the representative and of the new Protestant ethic on the continent with Emil Brunner as the representative. The analysis of Niebuhr's thought discloses that, as against Rauschenbusch's fairly simple identification of love and justice, he makes a sharper distinction between the two, and at the same time sets them in a dialectical relationship. As compared with Brunner, who develops a two level scheme similar to the Thomistic system where love applies principally to the personal sphere and justice to the social sphere, Niebuhr moves increasingly away from the traditional natural law base. His position on natural law might be characterized as one which is moving toward a formal natural law with a variable content, all kept under the criticism and inspiration of love as the only absolute principle.

Niebuhr makes a strong case for love as the primary motive for justice, and for justice as the chief instrument of love. The Protestant community may learn from him how to relate love to justice so that the cause of establishing justice will be strengthened.

Niebuhr's position is criticized on four main issues. (1) Against his view that love is sacrificial is juxtaposed the view that love is response to acceptance in community. Love is the spirit in any healthy community which drives toward the union of all in its inclusive good. Sacrificial

love is a species of this love. (2) Niebuhr defines his ultimate principle of love by abstracting from the event of Christ's death a single all-inclusive principle and then deducing from it other principles. He is criticized here not only for engaging in the doubtful practice of deductive ethics, but for not adequately defining the moral principles which must guide action. His definition of justice turns out to be pragmatic and therefore highly flexible. As over against this view the author defines justice as the acknowledgment of the responsibility for the community to exist and for men to be persons-in-community. Justice gives structure to the relationship which love creates. (3) Niebuhr believes in the primacy of faith, freedom, and love over the subordinate structures of reason, necessity, and justice. Niebuhr's treatment of love and justice would be cleared up appreciably if he could accept a revision of his view of faith and reason. It is suggested that he could find help at the same place he discovered his anthropology--namely, in the thought of St. Augustine. (4) Niebuhr moves from his ultimate principle of love to the decisions of practical life situations chiefly through the media of the individual, and pragmatic justice. The critic argues that it is much better to elaborate an objective pattern of action and middle principles which would give firm social norms. Microfilm \$4.00; Xerox \$13.40. 309 pages.

THE FIFTH AND SIXTH DEGREES OF  
CONTEMPLATION STUDIED IN THE CONTEXT  
OF THE LITURGICAL COMMUNITY FROM SOME  
NEWLY EDITED TEXTS OF RICHARD OF ST. VICTOR

(L. C. Card No. Mic 58-2830)

James Hardy Overton, Jr., Ph.D.  
Duke University, 1958

Supervisor: Ray C. Petry

Twelfth century monastic life can be said to have been characterized by ominous change and unrest. Disappointment in the Benedictine discipline, its too rigorous application in some instances, its inherent laxity in others, led to conflicting, even violent, reactions to monastic regulations. Harassed from within by dissensions that led to open rebellion or migration, and under pressure from feudal incriminations, the orders sought to adjust to both internal and external conditions. The Cistercians, for example, adhered to an austere rigoristic discipline in favor of ecclesiastical authority; consequently, swayed by the affective devotional outlook of Bernard of Clairvaux and others, they yielded to the temptation of an extreme ritualism.

In the order of Augustinian Canons Regular at this time, there was a constant attempt to establish an internal authority that would compare with that of the Benedictine orders--a search for a sane and balanced monachism. Asceticism combined with freedom appears to have been the happy balance that was sought.

This dissertation is concerned to show that Victorine contemplative life, practiced within the liturgical context of the community of Augustinian Canons Regular, reflects a flexible discipline, balanced between scholastic interests and mystical devotion. William of Champeaux, founder

of the Abbey of St. Victor, instigated this balanced program; its perpetuation was maintained by the scholarly theological work of Hugh of St. Victor. Known far and wide as a theologian, his outlook was penetrated by a deep understanding of human nature as well as a mystical devotion toward divine truth. Within his own Abbey, his mystical writings were placed on a level with works of Cassian and Gregory the Great.

Richard of St. Victor appears to many to have developed his mystical outlook and his strong desire to systematize theology from Hugh. Such an interpretation is not to be denied, but it remains that Richard himself developed and established a system that could be considered his own. He remained within the Victorine tradition; yet he employed those methods and incorporated many ideas that had found currency elsewhere. Both Hugh and Richard utilized patristic sources in their writings; likewise, they were very much aware of theological and philosophical developments of their own time.

The first two chapters of the dissertation seek to orient the contemplative vision of Richard of St. Victor within the context of twelfth century liturgical practices and to the Canonical office as known and used at St. Victor. Medieval liturgical usage, expanded to include myriads of new ceremonies and customs, left the way open for flexible application in many orders. But there was, in nearly every instance, a desire to continue to exercise the *Opus dei*, both for disciplinary reasons and normal devotional needs. The Augustinian Canons at St. Victor formulated their liturgical concepts gradually, basing them on a combination of rules, rather than on a single "Augustinian Rule." This thesis, together with a brief orientation in the direction of twelfth century Eucharistic devotion, makes up the content of the first chapter.

The second chapter is concerned to elucidate the internal conditions within the Abbey of St. Victor. Inasmuch as few histories of the Abbey exist, information concerning the interior life there is difficult to assimilate. The personages who made up the Victorine family preferred to remain anonymous. Nevertheless, I have gathered scattered factual matter to formulate some understanding of the Victorine family. As far as possible, data concerning the relation of the Abbey to the Church and to the French court is included. As much biographical information as could be assimilated has been incorporated in the second chapter.

The third and fourth chapters analyze and correlate the mystical theology of Richard of St. Victor as found in three of his most important writings: *The Benjamin Minor*, *The Benjamin Major* and *The Four Degrees of Violent Charity*. The fifth chapter is concerned to relate the Richardian mysticism to Victorine liturgy and ceremonial, employing the recently edited *Sermons* and *Spiritual Opuscles* of Richard known as *The Three Processions* and brought to light within the past decade by Jean Chatillon and others interested in the contemplative life as described and defined by Richard and the Victorine tradition. Unquestionably, with the results of such recent research, a new understanding of Victorine life and theology is being established. Before it is ended, a better comprehension of Victorine mysticism is inevitable.

Microfilm \$3.95; Xerox \$13.40. 308 pages.

## THE ANTI-ORIGENIST THEOLOGY OF METHODIUS OF OLYMPUS

(L. C. Card No. Mic 58-3243)

Lloyd George Patterson, Ph.D.  
Columbia University, 1958

This study treats the thought of Methodius of Olympus (d. 311 A.D.) in relation to the theological movements in the Greek east in the period in which the spread of Origenism confronted the Church with problems inherent in an Hellenistic (Platonic) interpretation of Christianity.

In the first part, an examination of the chronological order of the extant writings of Methodius is undertaken with a view to resolving apparent inconsistencies in his attitude toward Origen and explaining his misinterpretations of the Origenist system. Direct evidence places (the extant) *De resurrectione* and *De cibis* later than the *Symposium*, *De sanguisuga* earlier than *De resurrectione*. Analysis of differing treatments accorded themes common to various works suggests that *De lepra* and *De sanguisuga* (in that order) stand later than the *Symposium*. *De libero arbitrio* and *De creatis* appear respectively early and late, the former probably earlier than the *Symposium*, the latter possibly later than *De resurrectione*. Despite the tentativeness of certain of these assignments and the mystery surrounding the composition of *De resurrectione* (*De cibis* i. 1), the anti-Origenist writings--*De resurrectione* and *De creatis*, with *De cibis*--can be identified as later works.

In the light of this arrangement, Methodius appears as a naive adherent who eventually, probably as a result of criticism of the *Symposium*, turned to attack Origen. His later misinterpretations of the system are seen to stem from a misassociation of Origen's motives with those attributed to the Gnostics in *De libero arbitrio*, alleged anti-Origenist elements in which are thus explained.

In the second part, the thought of the earlier and later writings receives independent consideration. Despite various Origenist aspects, the early theology is a systematization of the thought of Clement of Alexandria within the framework of Irenaeus' view of creation as perfected through history. God has allowed physical passions to divert the progress of the soul toward its divine source in order to achieve the human plenitude through procreation, but he has also sought to have them brought under control. The passionlessness which will be characteristic of the resurrection body is already anticipated in Christ's teaching of virginity. Unaware of the problems which Origen saw involved in adherence to the Platonic world-view (however corrected by a Stoic concentration on the passions to the exclusion of the body), Methodius stands "on the other side" of Clement from Origen.

The anti-Origenist writings contain developments rather than radical changes in Methodius' thought, but they reveal the extent to which crystallization of his position resulted from opposition to Origen. His refutation of the concept of the eternal generation of the world (*De creatis*) accentuates a simple version of Origen's doctrine of generation in which chronological and ontological priority are confused and at least implies a view of the Logos which anticipates that of Arius. More significantly, his rejection of the double creation doctrine (*De resurrectione*) on the ground that the soul cannot sin without the body, leads to the assertion that the cessation of the movement of time will free the body from those material fluctuations which arouse

passions in the soul. A sophisticated version of this doctrine later provided Gregory of Nyssa with an intellectually viable explanation of the corruption of the physical order free from the pitfalls of Origenism.

While clarifying Methodius' attitude toward Origen, the study also shows how his Clementine theology was provided with answers to the questions posed by the great Alexandrian. As well as explaining Methodius' emergence as an anti-Origenist, it illuminates his contribution to the task of finding a rational alternative to the Origenist system.

Microfilm \$7.10; Xerox \$24.80. 560 pages.

#### KARL HEIM'S CONCEPTION OF THE APOLOGETIC TASK OF CHRISTIAN THEOLOGY

(L. C. Card No. Mic 58-2831)

John Pemberton III, Ph.D.  
Duke University, 1958

Supervisor: Robert E. Cushman

In his understanding of man's sinful plight and the means of grace Karl Heim is clearly indebted to the insights of the Biblical-Reformation position, but he has refused to conclude with other contemporary Protestant theologians that all questions concerning belief in God can be reduced to the problem of grace or works. Heim contends that while the doctrine of justification by grace alone eliminates both the Thomistic and Cartesian forms of natural theology from Christian theology, this central doctrine does not rule out the theological prolegomena necessary to a Christian formulation of an intelligible world view in terms of which to defend and commend the faith to the non-Christian mind. Theology must not isolate itself from the rest of man's knowledge. Rather, theology must face with the man of today not only the central question of belief, the question of the will of God; it must also be concerned with the preliminary question of the possibility of belief in God.

Heim believes that the traditional apologetic approach of attempting to meet the "secular" mind on its own grounds is fruitless. The hypotheses of science, to which the contemporary secular mind is dedicated, are transient and so too the world views built upon them. Hence the Christian apologist must meet the secular mind on other terms, which lie from the beginning outside the whole scope of natural science ("polar space").

Heim argues that there are two fundamental tasks for the apologist in confronting the "preliminary" question. First, the apologist must, by a process of fundamental questioning, bring the non-Christian to see the inadequacy of constructing a world view on the basis of a transient scientific hypothesis, the absolutizing of a relative. However, in the process of clearing away false absolutes, the apologist must perform a second task. By "maieutic instruction" he must bring up into the hearer's consciousness the unacknowledged presupposition of the non-objective background of the objective world, the world of I and thou, on the basis of which he can speak positively to the non-Christian. To become aware of the *Du-Verhältnis* is, according to Heim, to be aware of the reality of the experience of conscience (guilt and obligation), a reality that cannot be dismissed but that confronts man with the basic

question of human existence, the question of God. Hence, to say "thou" is to acknowledge the reality of estrangement and community, experiences which can only be comprehended in terms of the reality of a "transcendent" or "suprapolar Thou," the personal God.

However, Heim's ontological analysis of human existence is Christologically informed. It does not begin with man as such, but with man in estrangement, that is, with man in relation to the "transcendent" God revealed in Jesus Christ, the Word of God. For Heim the transcendence of God means not only God as "wholly other," but also God as Holy Spirit, Who is eternally present to man and known, although not acknowledged, by man in the experience of conscience. In virtue of this knowledge the apologist knows that he may meet the non-Christian, not only in the "polar space" of the objective world, but in the "Suprapolar space" of the Holy Spirit, which is the sole ground for man's knowing God.

Thus Heim's ontology preserves the priority of God in being and knowing, while at the same time providing for not only the possibility but the necessity of the apologetic task in Christian theology. Heim accomplishes this by replacing the cosmological arguments of traditional apologetics with the "suprapolar spatiality" of the Holy Spirit, which, in turn, preserves places for both ontology and Christology in the theological enterprise.

Microfilm \$6.90; Xerox \$24.20. 544 pages.

#### A COMPARISON OF TWO CURRENT AMERICAN ROMAN CATHOLIC THEORIES OF THE AMERICAN POLITICAL SYSTEM WITH PARTICULAR REFERENCE TO THE PROBLEM OF RELIGIOUS LIBERTY

(L. C. Card No. Mic 58-3247)

Thomas Griffin Sanders, Ph.D.  
Columbia University, 1958

Participation in the Roman Catholic Church involves commitment to a body of ethical teaching with social and political applications. Catholics have attempted since the American Revolution to show that the teaching of the Church does not contradict the American constitutional structure. The greatest tension lies in the area of religious liberty, where the Catholic concept of theological and moral freedom differs from religious freedom as a legal right bestowed by the Constitution.

A consideration of such major elements in Catholic political theory as the relationship between society and the state, natural law, the origin and end of the political order, and the origin and nature of political authority reveals that Catholic interpreters differ on many points, although where possible Catholic thought follows a consistent Aristotelian-Thomist pattern.

Two predominant approaches to American democracy are found within the contemporary American Catholic Church. One, the traditionalist view, evaluates the constitutional clauses on religion with the post-Reformation confessional state as a criterion. American democracy is regarded as an acceptable form of government which Catholics must patriotically support, but ideally the attainment of an overwhelmingly Catholic population and culture in the United States would lead to legal recognition and

patronization of the Catholic Church. Representatives of the other theory, the dynamic view, argue that the traditionalist interpreters have failed to consider the historical circumstances underlying both the relevant papal encyclicals and the confessional state itself, and that Thomist political theory does not countenance an ideal. The American political system is acceptable because the Church is free to carry out its spiritual objectives, and because harmony and cooperation prevail between the Church and the temporal order in such a way that the moral influence of the Church can be expressed in American society and institutions. The American arrangement of religious relations is not ideal, but no political order in history is ideal, and American Catholics have no logical obligation to change the American Constitution to fit a pre-conceived pattern.

The chief features of the dynamic criticism are in large part derived from its appropriation of the Augustinian views of society, the temporal government, the relationship between nature and grace, and the purpose of civil law. Furthermore, the dynamic theory reflects a use of historical criticism in interpreting the magisterium and actions of the Church.

The teaching of the present pope, Pius XII, leaves room for both theories, although any conclusions must be derived from scattered comments, since he has not specifically dealt with the problem.

Although both the traditionalist and the dynamic theories are designed to justify Catholic loyalty to the American government, the dynamic view tends to reduce tension between the Church and American society because it sets a more positive value on the antitheses of the traditional objectives of the Catholic Church in society: freedom along with order, rights with responsibility, liberty with law, and consent with authority. American government seeks to maintain a balance between both sides, as does the dynamic position. Furthermore, the dynamic theory contains no objective obligation to alter the existent structure of church-state separation, and it assumes a minimal correspondence of civil law with natural law.

Microfilm \$6.25; Xerox \$22.20. 491 pages.

## A STUDY OF DOXA AND CHRISTOLOGY

(L. C. Card No. Mic 58-2756)

Toshimi Tatsuyama, Th.D.  
Boston University School of Theology, 1958

Major Professor: Dr. Edwin P. Booth

### 1. A Statement of the Problem

The purpose of this study is to see how Jesus is God's doxa. It is an inquiry into the understanding and effects of doxa on the problem of Christology, of how the Word-Became-Flesh according to the Fourth Evangelist and of how the glory-of-God-was-revealed-in-the-face-of-Jesus-Christ according to Paul.

### 2. Procedure.

The study is approached at first historically and philologically by noting some of the background and problems, namely, the Aramaic, Hellenistic, Gnostic, and mythological background, and the problems of metaphysics, textual criticism, Koine Greek, revelation, history, and knowledge. The history of the word doxa is then traced from its Old Testament origin, later pre-Christian Judaistic and Septuagintal usage to the New Testament's dependence on the Septuagintal usage of it. The works of twenty-five scholars, primarily Arthur Ramsey, Rudolph Bultmann, Søren Kierkegaard, A. T. Robertson, and William Manson are surveyed for their views on doxa and Christology, particularly as they concerned John 1:14 and II Cor. 4:6. The use of doxa as a whole by Paul and the Fourth Evangelist is reviewed, and the special use of doxa to illuminate John 1:14 and II Cor. 4:6 is noted along with a summary comparison of Paul and the Fourth Evangelist. The study concludes with the bearing of Doxa on the problem of devotion, of the Trinity, and of mimesis, the imitation of Christ. A new hermeneutical approach called the inward-related-objectivity or a new kind of "existential understanding" is proposed and used throughout the study. This new (objective-doxological-soteriological) approach partly embodies the existential-ontological approach and the new theological approach of the pisteuein-ginoskein method of Paul and the Fourth Evangelist; and it includes taking an "objective" or "detached" view of the whole panorama, both of the mystery of God and its soteriological effects on the beholder.

### 3. Summary and Conclusion.

The different meanings of kabod and shekinah are fused in a single unity in doxa in an ontological-soteriological sense, so that the beholding of doxa manifests a saving-knowledge by way of the pisteuein-ginoskein relationship that the prosopon of Jesus Christ is the eikon of God beyond the psychological-metaphysical-historical-philological-theological considerations of Christology. In the pisteuein-ginoskein approach it is possible to see Jesus as God's doxa (not so much by physical sight as by a kind of soteriological awareness as he maintains a relation of love, obedience, and mutual indwelling with God in Jesus), and to see how the agape-aletheia-dunamis-exousia of God in Jesus Christ (in their existential-ontological extension) affect the beholder. Then, with an "objective" or "detached" view of this inner-related soteriological situation, the writer sees the limits of this approach, especially as it affects his imitation of Christ, in that, it leaves him humble in a dynamic-existential-pisteuein-ginoskein relationship with God in Christ. Doxa then reveals to man not only the doxa and eikon of God in Christ, but it also shows him the limits and joys of the huiothesia relationship, even as he receives and extends the agape and doxa of God. In this way, while the mystery is given new meaning and perspective, the mystery of the Word-Became-Flesh and the Doxa-as-revealed-in-the-face-of-the-Jesus-Christ remains. This is also attesting to the mystery of the unity of the will of God in Christ (whether of operation, activity, or purpose), of the unity of rule (whether of power, sovereignty, or authority), and of the unity of the ousia (whether of nature, substance, or being).

Microfilm \$5.65; Xerox \$20.00. 441 pages.

## SOCIAL PSYCHOLOGY

### A STUDY OF THE RELATIONSHIP BETWEEN SELF-CONCEPTS AND ATTITUDES TOWARD THE NEGRO AMONG SECONDARY SCHOOL PUPILS IN THREE SCHOOLS OF ARKANSAS

(L. C. Card No. Mic 58-2751)

Clifton Maurice Claye, Ed.D.  
University of Arkansas, 1958

Major Professor: R. K. Bent

This study investigated the magnitude of the relationship existing between self-concept and attitude toward the Negro among secondary school pupils in three secondary schools located in Arkansas. One of the schools (school A) was located in a city where the percentage of Negro population to the total population was 5.0. This school was integrated on the secondary level. Another of the schools (school B) was located in a city where the percentage of Negroes to the total population was 7.0. The school was not integrated on any level. The third school (school C) was located in a city where the percentage of Negroes to the total population was 21.0. This school was not integrated on any level.

The major hypotheses: (1) attitudes toward the Negro are related to one's concept of self; (2) there is some positive change in attitudes toward the Negro as pupils progress through secondary schools; consequently, there is some change in self-concept in the same direction; (3) changes in positive attitudes toward the Negro are accelerated through contact with Negroes in an integrated school; (4) there is a positive correlation between the ratio of Negroes to whites in a non-integrated situation and positive changes in attitudes toward the Negro.

#### PROCEDURE

Samples from the seventh, ninth, and twelfth grades in the three schools were tested on the Tennessee Department of Mental Health Self-Concept Scale and the Purdue University Scale for Measuring Attitudes toward Ethnic and National Groups. The means of these scores were tested for significance with the use of coefficients of correlation for relationship within grades, and for heterogeneity by means of analysis of variance for relationship between grades within and between schools.

#### FINDINGS

For the population studied the data did not confirm any of the hypotheses -- all of the hypotheses were rejected. When the means and variances were compared and tested for significance, the following were the findings:

1. Most people have positive self-concepts as measured by the instrument employed in this study.
2. Prejudice is widespread among the population studied, and the number of Negroes in any given situation has no influence on the amount or degree of prejudice as measured by the instrument employed.

3. On the basis of the population studied, the efforts being made by secondary schools to develop real and positive self-concepts among secondary school pupils are ineffective.

4. On the basis of the population studied, the efforts being made by secondary schools to develop positive attitudes toward the Negro among secondary school pupils are ineffective.

5. On the basis of the population studied, contact with Negroes by white secondary school pupils in a secondary school setting has no effect on the development of positive attitudes toward the Negro as children progress through school.

#### CONCLUSIONS

On the basis of population studied, the following are the conclusions:

1. There is no significant positive relationship between self-concept and attitude toward the Negro existing among secondary school pupils studied at this time.
2. The findings support those of other investigators who have concluded that most people have positive self-concepts.
3. If attitude toward the Negro is one of the major factors in school integration, the number of Negroes in any given locality does not make any difference in the success or failure of the venture.
4. Prejudice is found among secondary school pupils regardless of their familiarity with Negroes.
5. Experiences provided by secondary schools to develop positive attitudes toward the Negro among secondary school pupils are not effective in producing change.

Microfilm \$2.00; Xerox \$6.40. 132 pages.

### TREATMENT GOALS AND ORGANIZATIONAL BEHAVIOR: A STUDY OF AN EXPERIMENTAL PRISON CAMP

(L. C. Card No. Mic 58-3668)

Oscar Grusky, Ph.D.  
University of Michigan, 1958

Camp Davis, the object of this research, is an experimental prison camp created to treat and rehabilitate young first offenders by means of a modified group therapy technique called social education. The research sought to determine the impact of the treatment program on the social organization of the Camp. The methods of study were participant observation over a nine month time span, questionnaires, formal and informal interviews with the staff and the inmates, and examination of official records.

Since correctional organizations are particularly sensitive to internal crises the major goal of all prison settings is custodial. At Camp Davis it was found that treatment was relegated to a secondary position. As a result

of special circumstances, however, the top power positions in the Camp, the Supervisor and the counselor, were both more or less treatment-oriented.

The treatment-custody goal bifurcation was evidenced in role conflict among the staff members over their handling of the inmates. Moreover, those staff members who were committed to the treatment goal and those who were committed to the custodial goal tended to interact separately among themselves.

The formal socialization process centered around the overcoming of the inmate's earlier "status degradation" experiences which took place in the traditional prison from whence they came. It did this by 1. "renewing" the inmate's status by defining him as someone who was important to the Camp; and 2. committing him to immediate acceptance of the treatment goals.

The questionnaire and interview data both revealed that the inmates were very positively oriented toward the Camp, the staff and the treatment program. They were, in fact, more positive to their institution and to their staff than the inmates at a control institution, Warren Technical School, were toward their own institution and staff.

Not only were the relationships between the staff and the inmates cooperative ones, which is atypical in a prison setting, but the relationships between the inmate leaders and the staff were also cooperative. The leaders were, moreover, more well-adjusted to the Camp and more committed to the treatment program than were the non-leaders.

The succession of a custodially-oriented Supervisor to a position previously filled by a relatively treatment-oriented person initiated a natural experiment in the Camp. The extreme hostility of the inmates toward the strict and formal policies of the new Supervisor was demonstrated to have affected the functioning of the Camp. The informal leaders were shown to have served as sources of relative stability during the crisis.

Microfilm \$4.55; Xerox \$15.40. 356 pages.

#### CHARACTER STRUCTURE, SOCIAL STRUCTURE, AND DECISION BEHAVIOR

(L. C. Card No. Mic 58-3683)

David Johnson Kallen, Ph.D.  
University of Michigan, 1958

This study concerned individual and social determinants of decision making by adolescents. These determinants were: integration setting, character structure, and sex.

Integration setting refers to the nature of the social environment in which the individual operates. The mass setting contains individuals in entrepreneurial occupations; the bureaucratic setting contains individuals in large scale governmental or business organizations. Integration setting was indicated by the occupation of the father of the subjects. In decision making situations, mass people are expected to rely more on their own ideas while people in the bureaucratic setting are expected to rely more on the ideas of others.

Character structure refers to selected internal characteristics of the individual. Inner direction refers to reliance mainly on internal standards and goals as guides

to behavior, while other direction refers to reliance mainly on the standards and goals of others.

Two levels of character structure were identified. One indicates whether the values of the individual favor reliance on internal or external goals and standards. The other indicates whether the individual sees himself as behaving in an inner or other directed manner or in an inconsistent (mixed) manner in decision situations. This was measured by self reports of behavior.

Sex is a universal determinant of differences in behavior. These differences should be reflected in decision making.

The measures of decision making were: self reports of recognition and acceptance of influence from others in two situations, peer ratings of the amount of weight the person gives to his own ideas and to the ideas of peers and adults in making a decision, consistency of behavior, differences in the way he acts towards peers of different sexes, and the extent to which his values are similar to the values of selected groups.

Subjects were fifty-two middle class adolescents who lived in the suburbs of Philadelphia, St. Louis, and Chicago.

None of the independent variables singly related to a significant number of significant differences in the mean scores on the dependent variables. This study tested whether the pattern of high and low mean scores which initial analysis indicated characterized groupings of combinations of independent variables represented a response pattern of individuals in those groupings. Because of limitations of sample size two independent variables were tested at a time.

The interrelations of the independent variables indicated that males tend to have other related values and to fall into the mixed category in their self reports. Females tend to have inner directed values and to see themselves as clearly inner or other directed in the self report measure. Mass subjects have inner directed values while bureaucratic subjects have other directed values.

In four of the five groupings of independent variables, the patterns on decision making for group scores did seem to characterize individuals in the grouping. These were: sex and integration setting, sex and the value measure of character structure, sex and the action measure of character structure, and integration setting and the action measure of character structure. Pattern results for integration setting and the value measure of character structure were not significant.

Space limitations prevent giving the content of all the patterns. Illustrative findings were: other directed subjects and bureaucratic subjects tend to behave consistently and to act differently towards peers of different sexes. Other directed and bureaucratic patterns tended to be high on awareness and acceptance of influence from peers. Mass and inner directed subjects tended to be more oriented toward parental ideas.

The important findings indicate that it is the combination of two independent variables rather than any one of them which predicts to decision behavior among adolescents.

Microfilm \$2.45; Xerox \$8.60. 188 pages.

# AN EVALUATION OF THE EYSENCK R AND T SCALES AND THEIR RELATION TO PERSONALITY

(L. C. Card No. Mic 58-2814)

Louis Schatz, Ph.D.  
The American University, 1958

This study attempted to investigate some of the claims made by Hans Eysenck for his R and T scales, as presented in his book *The Psychology of Politics*, London: Routledge, Kegan Paul Ltd., 1954. The scales themselves are thought by Eysenck to represent measures of two basic factors which can account for political-social attitudes. R, measuring radicalism-conservatism, is seen as an attitude dimension, while T, for tender-toughmindedness, is presumably a measure of personality. The quadrants formed by these independent factors are then thought to be able to define the various political groups with communists locating themselves in the tough-radical quadrant and fascists in the tough-conservative quadrant. Both of these groups are further seen as tough-minded in opposition to the other political groups (e.g. socialists and conservatives) who would be found in the tender-radical and tender-conservative quadrants, and are therefore seen as sharing certain basic personality traits as these are elaborated in terms of "tough-tender-mindedness."

This study sought to investigate the personality correlates of the T scale, and sought further, to explore the inter-relationships between the R and T scales. A form of the R and T scales was administered to ninety-nine college seniors, along with the Edwards Personal Preference Schedule and a short background form containing a request for the respondents to locate themselves on a simple, unstructured, straight line political continuum (which was later scored from 1 to 5, from "left" to "right"). The T scale itself was also re-scored into two scales, humanitarianism and religionism, after two earlier found factors of

Ferguson which according to Eysenck bore a close resemblance to his own R and T factors.

Very briefly the following results were reported:

Tough-mindedness was not found to be characterized by extraversion, dominance or aggression as measured by the Edwards PPS and as claimed by Eysenck. In fact, R appeared to be as good a measure of these traits as did T. Humanitarianism, one of the two sub-scales of T which actually contributes to a tender-minded score also was found to be as good or better a measure of this personality type than was T itself.

The T scale was found to be almost as good a measure of political attitudes as expressed by the political self-ratings as was R. These two findings questioned the contention that T was a dimension of personality while R measured attitudes.

The two sub-scales of T, which used every T scale item scored in the same direction as T itself normally is scored, were both shown to be correlated with R, significantly and in different directions. Religionism was found to be significantly correlated with conservatism, and humanitarianism was found significantly correlated with radicalism. This suggested that much of the variance in T could be explained in terms of radicalism-conservatism and questioned whether respondents were not answering T in terms of R.

T, it was suggested did not appear to be a meaningful psychological dimension in terms of the personality traits described by Eysenck and doubt was expressed as to what T actually did represent. There was a strong suggestion that respondents' T scores reflected responses to the R scale or that responses to both reflected humanitarian and religious attitudes. It was suggested that personality similarities between communists and fascists, if there are any, probably could not be claimed on the strength of these instruments. The usefulness of these scales for further research was seriously questioned.

Microfilm \$2.00; Xerox \$5.40. 110 pages.

## SOCIOLOGY

### SOCIOLOGY, GENERAL

#### THE ETHICAL IDEAL OF THE PROFESSIONS: A SOCIOLOGICAL ANALYSIS OF THE ACADEMIC AND MEDICAL PROFESSIONS

(L. C. Card No. Mic 58-2837)

Audrey Farrell Borenstein, Ph.D.  
Louisiana State University, 1958

Supervisor: Professor Vernon J. Parenton

The ethical ideal of the traditional professions of law, medicine, teaching and the ministry is analyzed both through a review of the literature on the subject, and through the interpretations of that ideality by members of two selected traditional professions, academicians and physicians. The analysis is based upon the sociological theory concerned with the study of ethnics, and the major methodological

approaches developed by theorists for the purpose of conducting such studies. A combination of the normative and descriptive approaches is implemented. All the dimensions of the ethical ideal of the professions, including the dedication to work as a "calling" and ethical obligations to colleagues, to clientele, to institutions and the immediate community which form the context of professional work, and to society itself, are studied through thematic analysis of the literature on the subject. Apparent antinomies in the ethical ideal are found to be a function of the assignment of priority to one or more dimensions of the ethical ideal. An empirical analysis of the meaning of the professional ethical ideal to professional men is based upon twenty-five interviews with academicians, and twenty-five interviews with physicians in a southern city.

The traditional professions, rooted in the medieval period as was the university which nurtured the knowledge pertaining to each, became in time each a separate social entity. The specialization of knowledge not only divided

profession from profession, but members of the same profession from one another. This is particularly true of the academic profession, for whose members the cultivation, and dissemination and contributions to knowledge have become divisive tasks. Group solidarity is not a characteristic of the academic profession; hence, ethical obligations to colleagues, as well as to the university, were poorly defined. Physicians, on the other hand, manifest strong group solidarity. Their discussion of ethical obligations to the community, however, were less articulate than those of academicians.

On the basis of these interviews, the core of professional responsibility is found to be embodied in the practitioner-client relationship. Both academicians and physicians expressed the desire to approach the client in a direct and personal way, and both were aware of the disruption of the former intimacy of this relationship. Whether this be termed an aspect of *Gemeinschaft*, of organic solidarity, or of primary relations, the student or patient is treated as an end in himself, rather than as a means to other ends. It is through the clientele that the professional man subordinates his concern for personal welfare and material advancement to an ideal of service. Ethical obligations to clientele appear to be the most meaningful dimension of the ethical ideal of the professions as it was interpreted by professional men. Thus they appear to be the leading survival of that ideal as it has been elucidated by historians, philosophers, and social scientists as the unique characteristic of professional life.

This initial study of the ethical ideal of the professions would indicate a criterion of professional status beyond those most competently explored by many students of Sociology. On the basis of the present study, it may be stated that the process of secularization has been incomplete in the sphere of the traditional professions. Although they are in many respects remote from it, an ethical ideal has not been imputed to the traditional professions without reason. In a small measure, the traditional professions appear to contain that principle of human fraternity to which Durkheim refers numerous times in envisaging the future society. Microfilm \$5.80; Xerox \$20.60. 456 pages.

**THE JEWS OF BROWNSVILLE, 1880-1925:  
DEMOGRAPHIC, ECONOMIC, SOCIO-CULTURAL STUDY**

(L. C. Card No. Mic 58-3027)

Max Halpert, D.H.L.  
Yeshiva University, 1958

**OCCUPATIONAL MOBILITY FOR BROWNSVILLE JEWS  
1905**

It is important to observe at this time that conclusions, deductions and shrewd guesses regarding the occupational mobility and occupational choice of all the strata of the Jewish community have often been made on an a priori basis. No such data on this subject are available for the Jewish community nationwide; nor within the different individual community surveys made by individual surveyors or Jewish agencies.

The Hutchinson study\* of immigrants and their children, since it is based on the Federal Census, which does not classify information on the basis of religious and ethnic origin, does not make a comparison between the occupations

of Jewish parents and their children which would determine any occupational mobility by the second generation.

Hutchinson discusses the occupational distribution of the foreign and native-born, and makes a general comparison between these two elements but there is no special detailed reference to mobility among the Jewish native generation in comparison with their foreign parents.

Neither does Faubman in his study\* of occupational selection among Detroit Jews shed any light on occupational mobility by the Jewish second generation in comparison with the occupational distribution of his foreign-born parent. Faubman's study deals only with the occupational stratification between Jewish and non-Jewish youth in Detroit, and the role that education had played in their occupational selection.

Faubman does not include in his study the occupational distribution among Jewish immigrant parents and their native-born children to determine any occupational mobility. Furthermore, I do not think that Faubman's study could be representative of the Jews of Detroit, since his data, as he states, is restricted primarily to the Unemployed as culled from the Detroit's unemployment office.

Microfilm \$4.45; Xerox \$15.00. 348 pages.

\*) E. P. Hutchinson, *Immigrants and Their Children, 1850-1950* (John Wiley & Sons) 1956

\*) S. Joseph Faubman, *Jewish Social Studies; "Occupational Selections Among Detroit Jews"* (1949)

**A DISCRIMINANT ANALYSIS OF URBAN ATTITUDES  
TOWARD CONSUMER COOPERATIVES**

(L. C. Card No. Mic 58-3001)

John Harp, Ph.D.  
Iowa State College, 1958

Supervisor: Joe M. Bohlen

The major purposes of the present study were to determine the attitudinal and perceptual variables which are related to willingness to join and participate in consumer cooperatives, and to determine the larger aspects of organizational structure related to attitude formation.

The conceptual variable involved in predisposition to join and participate in consumer cooperatives was called structural cohesion, and was defined as the degree to which the units in a system are willing to accept the formal role of a given sub-system. The social system for the present study was the city of Superior, Wisconsin, which is comprised of a multitude of sub-systems.

A discriminant analysis was employed to predict willingness to join and participate in consumer cooperatives by a random sample of the residents of Superior, Wisconsin. The predictor variables used in the discriminant analysis were, attitude toward consumer cooperatives, as an index of the attractiveness of a given group; satisfaction with cooperatives as a negative index of relative deprivation; and understanding of cooperatives as a negative index of ambiguity.

Relationships significantly different from zero were found between structural cohesion and the concept of attractiveness, relative deprivation and ambiguity. Statistical tests were also performed to indicate the relative predictive effectiveness of each of the independent variables.

The intended contributions of the present study are as follows:

1. Methodological: The statistic known as discriminant analysis has application to sociological research, as well as its more common use in personnel selection.
2. Theoretical: Conceptual variable analysis can be used to establish "families" of hypotheses within a given sub-division of sociological research.
3. Pragmatic: Social organization variables are related to attitudes toward joining and participating in consumer cooperatives. An understanding of these relationships is essential to the growth and development of consumer cooperatives in urban centers.

Microfilm \$2.00; Xerox \$6.00. 123 pages.

#### A STUDY OF SELECTED METHODS OF DELINEATING HOMOGENEOUS SUB-AREAS

(L. C. Card No. Mic 58-2828)

John Chase Howell, Ph.D.  
Duke University, 1958

Supervisor: Clarence H. Schettler

The purpose of this study was threefold: first, to examine the rationale which certain professional students employ to justify their delineation of homogeneous sub-areas within urban communities; second, to examine selected methods which have been devised to delineate such areas; and third, to inquire into the possibilities of one procedure for delineating homogeneous sub-areas designed to cope with certain problems involved in other approaches.

Toward this end a theoretical definition of homogeneous sub-area was formulated. This was further specified by the introduction of three constructs subsumed under this general term. These were natural area, census tract, and social area (as defined in the respective urban typologies of Shevky and associates and of Tryon).

Conceptual analyses of these three terms indicated a link extending beyond the logical relationship existing by virtue of the fact that all may be viewed, in theory, as types of the homogeneous sub-area. In part, this relationship was seen to be derivational in nature.

An examination of the relevant literature indicated that the constructs of natural area and census tract have occupied a significant place among the conceptual tools of students of urban life. While of recent vintage, Shevky's social area analysis and Tryon's cluster analysis have generated considerable interest.

Conceptual clarity was added by an examination of selected methods used to delineate these types of the homogeneous sub-area. Particular attention was paid to the attribution of the characteristic of homogeneity to the actual substantive areal units delineated in terms of these procedures. A formal analysis of certain difficulties attendant to the delineation of sub-areas characterized by homogeneity was presented. In actual practice, in varying degrees, this theoretical characteristic of homogeneity was seen as being violated.

In order to more properly evaluate this problem of homogeneity and related problematic aspects, an empirical investigation which was designed to inquire into the possibilities of one approach to the delineation of homogeneous sub-areas was presented. The approach was an adaptation of scalogram analysis. The universe of content was comprised of selected housing characteristics as reported in the 1950 census for Durham, North Carolina. Applying the method to these data, the three hypotheses formulated received affirmative support; namely, that selected housing characteristics are amenable to scalogram analysis, that such housing characteristics can be ordered in terms of a single unidimensional continuum, and that the resulting scale types may be used to delineate sub-areas within the city.

The problem of homogeneity was reintroduced by raising the question as to the legitimacy of attributing homogeneity to the sub-areas delineated in terms of housing scale types. The attribution of this characteristic to the sub-areas was considered to be a hypothetical matter outside the scope of the present study. However, it was suggested that internal homogeneity of areal units can be tested for housing data in a systematic and economical way by virtue of the fact that these data are published by blocks for some 209 American cities. Toward this end, two possible techniques for testing the hypothesis of internal homogeneity were suggested.

Other problematic aspects raised in the study were related to the procedure presented. It was concluded, however, that the full significance of the study was dependent upon further investigation of certain propositions suggested in the study. The basis of these hypotheses for further research rested, for the most part, upon the hypothetical question of the utility of the procedures outlined and of the sub-areas that were delineated.

Microfilm \$2.70; Xerox \$9.40. 208 pages.

#### THE INFLUX AND EXODUS OF MIGRANTS AMONG THE 47 PREFECTURES IN JAPAN, 1920-1935

(L. C. Card No. Mic 58-3684)

Yoshiko Kasahara, Ph.D.  
University of Michigan, 1958

This study aims at reconstructing the historic trends in migration in industrializing Japan over the fifteen years from 1920 to 1935. On the basis of estimates of net migration by age and sex for the 47 prefectures, variations in the volume and rate of population growth and decline due to migration among the prefectures are examined. Analysis of the age-sex differentials in migration is of importance as the first step toward gaining insight into the significant implications--demographic, social, and economic--of the population redistribution that accompanied the modernization of the country.

Net migration gains and losses among the prefectures are estimated by the life-table survival rate method for the six age groups, 10-14, 15-19, 20-24, 25-34, 35-44, and 45-64 of each sex over the three consecutive periods of 1920-25, 1925-30, and 1930-35. In order to measure the relative impact of net migration upon local population change, the indexes of net migration by age and sex are computed for all the 47 prefectures; they represent the

percentages of estimated net migrations over a given intercensal period to the "expected survivors" of the comparable cohorts of local populations enumerated at the beginning of the period. Finally, as an attempt to assess the effect of age-sex differentials in migration upon the structure of a given base population, the sex ratio and percentage distribution by age of a hypothetical population of "expected survivors" are compared with those of the corresponding observed population for selected prefectures.

The results indicate that the patterns of population change due to migration varied widely by age, by sex, and by locality as well as over time. In response to significant changes in the utilization of Japan's manpower introduced by the development of modern industrial technology, the stream of migration flowed primarily from rural to industrial areas. The large-scale population movement toward urban centers, moreover, appears to have accelerated its pace as Japan's industrial economy gained in maturity, continuing to increase even during the 1930-35 period including the depression years. For all the local variations witnessed in sex selectivity in migration, apparently more men tended to migrate than women, if judged by the aggregate figures of net gains and losses for the country as a whole.

The most mobile population in Japan over the entire fifteen years under study was at ages between 10 and 24, with maximum migration occurring among the 15-19 age group for both the males and the females. The impressive magnitude of occupational migration among peasant boys and girls in their teens and early twenties is clearly indicated by the disproportionately heavy net migration gains and losses in these age groups as well as the highly unbalanced sex ratio of the migrant population in many of the prefectures. Among the older age groups above 25, the volume of net migration decreased sharply. Furthermore, some of the industrial prefectures which gained substantially in the younger age groups became losing areas among the older age groups, while not a few rural prefectures which lost heavily among the younger age groups showed an appreciable gain among males in the 25-34 age group. A backflow of migrants from urban to rural areas is suggested in this apparent shift in the predominant direction of migration.

Variations observed in the volume and direction of migration by age and sex as well as over space and time, when taken as a whole, support the proposition that migration is in general a reflection of the "push" and "pull" relationships between the sending and the receiving areas. The resultant concentration of rural youth in the major industrial centers and corresponding depopulation tendency in agricultural areas are not only of demographic significance but immediately point up the social, economic, and cultural implications of a large-scale demographic shift which was in progress in Japan over the fifteen years under examination. Microfilm \$2.45; Xerox \$8.40. 185 pages.

# A STUDY OF THE SOCIAL INTEGRATION OF CATHOLIC MIGRANTS IN A SOUTHERN COMMUNITY

(L. C. Card No. Mic 58-2794)

William Thomas Liu, Ph.D.  
The Florida State University, 1958

Adviser: Charles M. Grigg

Many earlier studies have focused upon the adjustment of southern migrants in northern communities. This study attempted to study the reverse pattern. In order to focus sharply on the relationship between normative integration and the adjustive process, the Catholic population of the migrant group was chosen, since it was assumed that there are certain areas where the official pronouncements of the Catholic Church and the traditional values of the South are incompatible. In the descriptive part of the study, social backgrounds of American Catholicism and of the American South were analyzed and documented.

A small Catholic urban parish situated in the upper part of Florida was chosen for this study. A total enumeration of the parish was undertaken with the exception of inter-faith families and single or unattached individuals for fear of bias of the data. A number of non-migrants and Negro Catholic families were also excluded in the final analysis. This left a total of 98 couples who responded to the questionnaire. Field work took place between December, 1957 and March, 1958.

The questionnaire consisted of a number of background information items and seven sets of scales designed to measure the total integration of the couples studied. Four scales represented a composite area of "religio-social" attitude. One scale measured the degree of southern identification. The remaining two scales were the Chapin Social Participation Scale and the Wallin Women's Neighborliness Scale. All seven scales met the Guttman criteria. The degree of the individual's Catholicity was measured by the modified criteria of Fichter's typologies.

Working hypotheses of this study were: (1) the length of residence in the host community was directly related to the general integration pattern of the individual; (2) the degree of Catholicity was inversely related to the general integration of the couples; (3) the degree of Catholicity was inversely related to the degree of southern identification; (4) the socio-economic characteristics of the individual tended to modify the pattern of general integration. Corollaries of these general hypotheses were tested by using the chi-square tests.

The findings of this study suggest the following: (1) only two scale scores in the general area of religio-social attitude were found to be related to the Catholicity of the individual. They were Church doctrine and birth control scales; (2) Church doctrine, birth control, and race issues scales were influenced by the mobility pattern of the individuals studied; (3) religious education had no influence on the religio-social attitude; (4) age seemed to be responsible for the attitude toward race issues--elders were more conservative; (5) favorable Catholic attitude toward birth control issues on the part of the wife was influenced by the occupational and income prestige of the husband; (6) longer length of residence was found to be responsible for the more conservative attitude toward race issues; (7) the extent of participation in formal groups was influenced not only by the socio-economic status of the migrants, but also

by the degree of Catholicity of the individual; (8) the degree of southern identification was found to be influenced by the length of residence, the family income, and the age of the individual; (9) more conservative attitudes toward race and labor issues were found to be identified with the higher scores on the Southern Identification Scale.

From the available data, several points seemed to be significant: (1) since Catholicity was not found to be an important variable in determining one's general pattern of integration in this study, other factors such as length of residence played important roles in the adjustive process of the individual migrant; (2) there was evidence that the desire to conform to the class values is important in making up the blueprint of actual behavior pattern, particularly in social participation, including those of religious functions; (3) multiple-group membership of the migrants provided a basis for divided loyalty, especially when practical life experience required a different identity of values.

Microfilm \$2.15; Xerox \$7.60. 163 pages.

#### SOCIAL CLASS AND VALUE DIFFERENCES AMONG AMERICAN COLLEGE STUDENTS

(L. C. Card No. Mic 58-3238)

Norman Miller, Ph.D.  
Columbia University, 1958

This study deals with social class differences among college students with respect to class identification, and attitudes toward civil rights, organized labor, and political-economic issues.

Two major questions were raised: (1) the extent to which present socio-economic status, among individuals whose status aspirations are relatively similar, can be seen as an important variable in attitude formation; (2) the conditions under which the impact of socio-economic status on attitudes becomes either more or less pronounced.

The subjects were 4,585 male college students from eleven American colleges and universities, each student being asked to complete a lengthy self-administered questionnaire. An Index of Socio-Economic Status, or SES, a Civil Rights Score, a Labor Score, and a Political-Economic Score were constructed from some of the individual questionnaire items.

Class identification responses vary with SES, but not with future income expectations. Holding SES constant, Catholic students are more likely to regard themselves as working class than either Protestants or Jews. SES differences with respect to class identification are smallest among Jews, largest among Catholics. Students from rural areas are more likely to identify themselves as working class than those from large cities, and SES differences with respect to class identification are smaller among the former group. Sons of Republicans identify themselves as upper class more often than do sons of Democrats from similar SES levels. Ivy League college students are more likely than those from State colleges to identify themselves as upper or middle class; this holds true at every SES level.

No clear-cut relationship was found to obtain between SES and attitudes toward civil rights. Protestants become less tolerant with declining SES. Catholics show no SES

differences in this regard, and Jews become more tolerant with declining SES. Holding SES constant, the following were more likely to be pro-civil rights: non-southerners, urban dwellers, Jews, seniors, Ivy League students, liberal art majors, and non-fraternity members. Holding each of the above variables constant, high SES students are more liberal than low SES students, but this is due to the large proportion of Protestants in the sample. The direction of SES differences with respect to civil rights varies with religious affiliation.

In general, low SES students are more pro-labor than high SES students, and those identifying themselves as working class are more pro-labor than those identifying themselves as upper class. Holding SES constant, the following were more likely to be pro-labor: non-southerners, urban dwellers, Jews, Democrats, upperclassmen, Ivy League students, non-fraternity members. SES differences with respect to the Labor Score are greater among Catholics than they are among Jews. Holding party preference constant, SES differences with respect to the Labor Score disappear; this suggests that party preference is more highly correlated with attitudes toward organized labor than is SES.

There are practically no SES differences with respect to political-economic issues. The attributes associated with pro-labor attitudes are also associated with political-economic liberalism. With both type of college and year at school held constant, low SES students are seen as more liberal than high SES students, but the first two variables seem to be more important correlates of the PE Score.

The study concludes with the suggestion that SES, as a determinant of certain attitudes, may play a less important and consistent role than do other factors. It is further suggested that class position in a not very class-conscious society may be better understood as one dimension of a status complex which includes ethnic and religious statuses as well. Microfilm \$3.25; Xerox \$11.20. 251 pages.

#### THE MATURITY OF DELINQUENT AND NON-DELINQUENT ADOLESCENTS AS DEFINED BY THE DEVELOPMENTAL TASK CONCEPT

(Publication No. 21,594)

Irving Eugene Mitchell, Ph.D.  
Boston University Graduate School, 1957

Major Professor: Professor Albert Morris

#### I. STATEMENT OF THE PROBLEM

**Purposes.** The purposes of this study are: (1) to evaluate and compare the maturity of adolescent delinquents and non-delinquents as defined by the developmental task concept; (2) to study and evaluate the relationship that exists between adolescent maturity as defined above and social adjustment as measured by the Washburne Social-Adjustment Inventory; (3) to examine the relationship that exists between intelligence, as measured by standard IQ tests, and maturity; and (4) to assess the relationship that exists between maturity and occupational prestige of parents, as measured by the North-Hatt Scale.

**Major Hypothesis.** Stated in null form, there is no

significant difference in the maturity of adolescent delinquents and non-delinquents as defined by the developmental task concept.

**Subsidiary Hypotheses.** Stated in null form, (1) there is no significant relationship between maturity and occupational prestige of the samples' parents; (2) there is no significant relationship between maturity and social adjustment; (3) there is no significant relationship between maturity and intelligence; (4) there is no significant difference in the maturity of adolescent boys and girls, delinquent or non-delinquent.

## II. PROCEDURE OF THE STUDY

**Subjects.** The subjects compared consist of two groups: non-delinquent and delinquent. The non-delinquent group is composed of 505 students in the ninth grades of the four Junior High Schools of Newark, Ohio, and students of the ninth grades of the Washington-Utica High School. The delinquent group is composed of 187 students in the ninth grades of the Boys Industrial School, Lancaster, Ohio, and the Girls Industrial School, Delaware, Ohio.

**Methods.** The hypotheses were tested by administering the following instruments: (1) the McCleery Scale of Adolescent Development designed to measure maturity, as defined by the developmental task concept, (2) the Washburne Social-Adjustment Inventory designed to measure social adjustment, (3) the North-Hatt Scale designed to measure occupational prestige, and (4) standardized intelligence tests. The data were analyzed by means of standard statistical techniques to determine if significant differences or relationships existed between the scores of the delinquent and non-delinquent subjects. Other methods used were unstructured interviews, formal questionnaires and observation.

## III. RESULTS AND CONCLUSIONS

**Major Hypothesis.** No significant difference between delinquent and non-delinquent Total Maturity scores was found at the 5% level when the "t" test was applied. Significant differences were found between the scores of delinquent and non-delinquent girls on the subtests, Occupational Preparation and Family Life. The difference in the Family Life score was found to be the result of a tautology. A significant difference was found between delinquent and non-delinquent boys on the subtests, Social Role and Civic Competence. The difference in the Civic Competence score was found to be partially the result of the delinquents' unique experience with professionally trained people. The conclusion was reached that delinquent boys and girls are similar in total maturation to non-delinquent boys and girls and that total maturity, per se, is not an important factor in delinquency. However, lack of maturity in an essential developmental task or tasks may result in delinquency.

**Subsidiary Hypotheses.** (1) The relationship existing between occupational prestige ratings of parents and Total Maturity scores of their children is negligible. (2) No significant relationship between maturity and social adjustment was found to exist for either of the samples. (3) The relationship existing between maturity and intelligence was found to be negligible. (4) It was concluded that as far as the developmental tasks are concerned, the boys,

delinquent and non-delinquent were more mature in most instances than the girls.

Microfilm \$2.55; Xerox \$9.00. 196 pages. Mic 58-5080

## THE LIFE INSURANCE MAN: A SOCIOLOGICAL ANALYSIS OF THE OCCUPATION

(L. C. Card No. Mic 58-2854)

Miller Lee Taylor, Ph.D.  
Louisiana State University, 1958

Supervisor: Associate Professor Roland J. Pellegrin

This is an occupational study of life insurance men (both producers and administrators) in a sociological frame of reference. The purpose of the study is to contribute to the growing body of knowledge concerning occupations. It is intended to be of interest to practitioners, to persons interested in acquiring a knowledge of the occupation and, primarily, to social scientists.

Data for the study came from the literature on life insurance and personal interviews with life insurance men. The literature analyzed consisted mainly of trade journal and company publications. It was treated as an expression of the "official" ideology of life insurance men. Interviews were held with sixty-four practitioners (producers and administrators). Respondents were selected by using a quota sample so that they would represent companies domiciled in all regions of the country, from the oldest to the newest companies and from conservative and liberal companies. Respondents ranged from practitioners with long careers in life insurance to part-time men. Data from the literature and the interviews were compared whenever feasible to bring into focus differences and consistencies between official ideology and actual practice.

The occupation is described and analyzed primarily by using the sociological concepts of structure, organization and function. Since the study is a "pioneering" one, no attempt is made to test specific hypotheses. The research design, however, is systematically organized for the study of certain areas of occupational importance, such as recruitment, training, remuneration and others. It also provides for the investigation of the work situation, client relationships and career patterns.

The analysis brings to light several areas of disunity and ideological conflict in the occupational culture of the life insurance man. One of the most significant areas of disunity in the occupation is the result of ideological differences between rugged individualists and security-oriented practitioners. Rugged individualists may be career oriented, but their ideological approach to their work contributes little to the integrated growth of the occupation. The ideology of security-oriented life insurance men leads naturally to an integrated occupation. In fact, there is a suggestion that some men who follow the new ideology see the occupation not as a means to an end but as an end in itself.

Basic differences in ideology among life insurance men are witnessed throughout the whole of the occupational organization, but they are being minimized by new recruiting, training and remuneration processes which are calculated

to produce security-oriented men. Systematization of the recruiting process through the use of aptitude tests, profiles and a series of interviews is intended to bring into the occupation only men of high quality.

Advanced training is used to promote professionalization in the occupation. However, certain training is in excess of what is required to fulfill the job, and many life insurance men are reluctant to take the training for this reason. Training of practitioners cannot exceed a point which is functional with regard to the occupation's service to society as well as to its internal goal of professionalization.

Within the area of occupational organization the work situation is characterized by much insecurity. Client relationships vary with the socio-economic class of the policyholder, and the trend toward professionalization tends to result in more service for upper class clientele. Career patterns are sharply divided between selling and management, and the former is gaining prestige over the latter. The two careers, however, are necessary for the occupation.

In sum, it is observed that the structure, organization and function of the occupation are determinant for the social behavior of life insurance men.

Microfilm \$5.75; Xerox \$20.20. 450 pages.

## SOCIOLOGY, FAMILY

### THE RELATIONSHIP OF NON-FAMILIAL ACTIVITIES TO FERTILITY BEHAVIOR

(L. C. Card No. Mic 58-3646)

Jeanne Elizabeth Clare, Ph.D.  
University of Michigan, 1958

The purpose of this study was to investigate the relationship of non-familial activities of wives to their fertility behavior. Two areas of non-familial activity were investigated namely, work and clubs. Three different measures of work were utilized: current labor force participation, years worked since marriage and expectation of working in the future. The extent of a woman's participation in clubs was used as the measure of club activity. The aspects of fertility behavior investigated were the use and intention to use some method of family limitation, effectiveness of fertility planning, present size of family and expected completed size of family. It was reasoned that the degree of involvement of the wife in other social groups besides the family must have a differential impact upon her fertility behavior. Not only is the mother role time consuming, but the nature of the role itself is resistant to any expansion of activities outside the home. When this does occur it is believed that family size will be depressed.

The method employed in this study was essentially ex-post-facto. However, the data on expected completed family size does permit some approximation of a causal type analysis. The data were collected in the spring of 1955 in connection with "The Growth of American Families Study." Interviews were carried out with a cross-section sample of 2713 white married women, 18 to 39 years of age, with

husband present in the household. This study is confined to the 1794 women classified as fecund.

For one area of non-familial activity, work, a positive relationship was found with the use and intention to use some contraceptive method and effectiveness in fertility planning. An inverse relationship was found between work and present and expected family size. Years worked since marriage proved to be the most highly related variable to the different aspects of fertility behavior. The longer a woman has worked the more likely it is that she used some contraceptive method and the more effective her fertility planning. Moreover, women with work experience presently have a smaller family size and expect a smaller family size than women with no working experience. A similar relationship was found to prevail for currently working women. However, currently working women were more likely at present to be childless. Expectation of working in the future was found to be related to only two aspects of fertility behavior, namely, use of some method and expected completed family size. Little or no consistent relationship was found for expectation of work and current and expected family size.

Activity in clubs was not found to be consistently related to fertility behavior. Only for two of the measures of fertility behavior, use of some contraceptive method and effectiveness in fertility planning was there any indication of a relationship. Club women were more likely to have used a contraceptive method and to be moderately successful in their fertility planning. However, club women have to date had a slightly larger size family than non-club members and expect about the same or slightly larger family size than do non-club members.

Microfilm \$5.60; Xerox \$19.80. 438 pages.

### FAMILY ROLE STRUCTURE AND FERTILITY

(L. C. Card No. Mic 58-3663)

David Goldberg, Ph.D.  
University of Michigan, 1958

This research had two objectives. One was to describe certain changes in fertility patterns as these were related to socioeconomic characteristics. For some time now demographers have suggested that variables such as income, occupation, and education merely reflected underlying differences in life styles, which in themselves should be treated as the "causal" variable in fertility research. Thus, our second objective was to set forth a series of hypotheses tapping differences in selected characteristics of the family and to relate these characteristics to fertility values and behavior.

The data upon which the research was based came from interviews taken with a representative sample of adults in metropolitan Detroit. Data were collected through the facilities of the Detroit Area Study.

The major dependent variables of the study were actual number of children for women over 40, and expected number of children for women under 40. Various indirect checks of the stated expectations indicated that these data were "reasonable."

Some of the descriptive findings showed that:

- (1) There is likely to be a shift from two to three

children families among the marriages contracted since World War II. In fact, women who are now between the ages of 26 and 34 have already had as many children as women over 40.

(2) The traditional inverse relationships between fertility and socioeconomic status, observed among the older women, are now being greatly diminished and are likely to disappear in the younger generations of women, if the stated expectations are realized.

(3) The inverse pattern of fertility that exists for all the older Detroit families can be attributed to the fertility behavior of rural elements who migrated to the city. A combination of the relatively high fertility of migrants with the differential selectivity of various status categories for these rural migrants produced the inverse fertility pattern in Detroit. Among the two generation urbanites, there are practically no differences in fertility between socioeconomic groups.

Using a subsample of 221 cases of fecund women between the ages of 17 and 32, the relationship between family role structure and expected number of children was explored. Family size was hypothesized as being a direct function of a) the amount of home centered activities of the wife, b) the ratio of kin contact to non-kin contact, and c) the availability of services or economic aid from relatives.

The analysis was carried out under controls for life cycle development and the internal power structure of the family. It was found that the proportions of home and family centered activities were related to decisions about family size only among wife dominant couples and among couples at early stages of their marriage. For husband dominant couples, expected number of children was found to be a direct function of the status characteristics of the family. The decision to have additional children also seemed to be based on status characteristics among couples who had already given birth to two or three children.

The different pressures exerted on the family building process by husband and wife have a tendency to cancel one another. As family status increases the wife is likely to become more actively engaged in formal organization activities and to be exposed to whole new areas of consumption that may shift the balance of roles away from the home. Under these conditions the husband will exert pressure for a large family while the wife is likely to exert pressures in the opposite direction. The converse situation may balance pressures among the couples of lower socioeconomic status. These findings help to explain the lack of any significant difference in expected family size among the various social and economic groupings that were analyzed.

Microfilm \$2.75; Xerox \$9.40. 209 pages.

#### A STUDY OF SERVICES FOR THE FAMILY IN SELECTED FAMILY-SERVING YOUNG MEN'S CHRISTIAN ASSOCIATIONS

(L. C. Card No. Mic 58-2796)

Louis Edward Nelson, Ed.D.  
The Florida State University, 1958

This project was an analysis of services for the family by twenty city Young Men's Associations in the United

States. The Associations studied were selected from among 468 which had participated in a preliminary review of services rendered, and which had indicated that services directed toward meeting needs of the family were part of their local programs. The data were collected with questionnaires, and supplemented with personal correspondence. The study was supported in part by grant from the National Council's Research Committee.

The following were the major conclusions. The data in this and related studies showed an increasing tendency on the part of local Associations to emphasize services to the family as a group, rather than to individuals of the male sex only. The Associations studied had followed a common pattern in the development of these services, as follows: (1) the inception of an interest in serving the family, usually on the part of the professional program staff; (2) the initiation of "special event" programs designed to include all members of the family; (3) the introduction of regularly scheduled programs intended to include all members of the family; (4) the introduction of definitive statements of purpose re the family into the formal written policy of the Association; and (5) the provision of memberships for families as such.

Responsibilities for services to the family were, for the professional staff, integrated with other tasks rather than kept separate. Committees related to group work programs had more responsibilities for services to the family than did other committees. Parents of "youth members" were involved, to a greater extent, as general program leaders in youth work than as leaders of youth club groups. Various family membership plans were reported, but the "package" plan (all eligible members of the family included in one stated fee) was reported most frequently. The mean family-membership fee was \$28.75 a year. Family-membership provisions were introduced by local Associations and were not recognized by the National Young Men's Christian Association.

The growing emphasis upon services for families was interpreted, by the respondents, in a broad context and included more than direct services to the family as a group. This emphasis included programs which encouraged joint participation by members of families, such as father-son programs, as well as programs for the total family. Education for family living was found in informal educational classes and in the use of family-life topics as programs at meetings of club groups. Services for the family were found, to a limited degree, in Association-wide programs and camping programs.

The experiences of the respondents indicated that this growing emphasis upon services for the family had been a constructive influence in more than half of the reporting family-serving Associations. It was helpful in such areas as committee work, recruiting of leaders for youth work, program development, and was especially helpful in the recruiting of new members, in membership renewals, and in YMCA-community relations.

Microfilm \$2.00; Xerox \$5.80. 116 pages.

## SOCIOLOGY, RACE QUESTION

A SOCIOLOGICAL STUDY OF THE  
CHOCTAW INDIANS IN MISSISSIPPI

(L. C. Card No. Mic 58-2856)

Charles Madden Tolbert, Ph.D.  
Louisiana State University, 1958

Supervisor: Professor Vernon J. Parenton

The primary objective of this study is to analyze social relationships in a tri-racial setting with particular emphasis on the Choctaw Indians living in Mississippi. A secondary objective is concerned with tracing the social history of the Mississippi Choctaws since 1830.

The theoretical framework of the study involves the use of the situational approach. Emphasis is placed on stereotypes and their place in defining situations. Stereotypes which have prevailed at various periods in history of Indian-white relations are recorded. On the basis of these stereotypes situations are defined. The resulting patterns of behavior are evidence of the theory of the self-fulfilling prophecy. The study is threaded together with a description of the changes which have taken place among the Choctaws in historical times.

The Choctaw Indians living in four counties (designated the agency area) in Mississippi are the object of study. Data presented are from three sources: participant observation, unstructured interviews, and historical documents. With background information provided by a historical sketch and an analysis of demographic data, the analysis of social organization is undertaken. Special attention is given to major institutional areas--the family, education, religion, and economic life.

The findings of this study indicate that the social organization of the Choctaws has been practically destroyed by three separate removals of Indians from Mississippi. Population of the Indians remaining in Mississippi has fluctuated highly since the first removal in 1830. The present population is growing rapidly but it is offset by the migration from the area.

The family has been the mainstay of the Choctaws through the years. The contemporary family is patriarchal; kinship is reckoned as it is among whites in the larger society. The status of women is low; however, it is rising at the present.

Among the Indians there are distinguishable three classes: the native, transitional, and marginal. In the class structure of the larger society the Indians are on the bottom. There is a semi-caste wall separating the three races in the agency area. Because of migration of young people, the Indians are deprived of leadership.

In the area of education, the Choctaws have one of the lowest attainments among all Indians. In 1953 the first Mississippi Choctaw Indian graduated from college. Presently the Indians are trying to secure a four-year high-school.

About half of the Indians are members of Christian churches. Over three-fourths of the church members are Baptists. The church house has been an important place for social contacts for Indians widely scattered on farms.

The economic condition of the Choctaws is among the lowest in the country. Over three-fourths of them are farmers--sharecroppers or tenants. Because of prevailing stereotypes, Indians are unable to get work in cities in the reservation area.

In one community of the agency area different patterns of relationships between Indians and whites were observed. Upon investigation it was learned that the particular Indians who inhabit the community are defined somewhat differently from other Indians. A school has been maintained in this community longer than in the others.

On the basis of the findings of the study, it is concluded that the Indian's problem is not one primarily of acculturation but one of assimilation. There are varying degrees of acculturation, but those who are most acculturated, the marginals, are not accepted in the larger society. Because of the way the Indians are defined and treated by whites in the agency area, the process of acculturation is hindered. Mutual trust and understanding are the basis for the good relationships prevailing in the exceptional community.

Microfilm \$3.85; Xerox \$13.00. 299 pages.

## SPEECH - THEATER

AN ANALYSIS OF THE PERSUASIVE TECHNIQUES  
IN THE SPEAKING OF BENJAMIN F. FAIRLESS,  
1946-1956

(L. C. Card No. Mic 58-2785)

Richard M. Baker, Jr., Ph.D.  
The Florida State University, 1958

Sixty-six speeches, statements, and broadcasts were analyzed in this study using the classical canons of rhetorical criticism as criteria. This report includes a biographical sketch, a discussion of the social milieu, and chapters on Fairless' ideas and arguments, speech composition, adaptation to his audience, and effectiveness.

Fairless worked his way through school and college. He began in steel in 1913 and rose to the presidency of Central Steel. Next he moved to Republic Steel, and in 1935 went to a U. S. Steel subsidiary. In 1938 he became president of U. S. Steel. In 1952 he was made chairman of the board, retiring in 1955 at 65.

Fairless describes free enterprise as hampered by (1) inflationary government fiscal policies and labor demands; (2) government taxation policies which dry up the sources of expansion capital; (3) confiscatory and unreasonable taxation; (4) refusal to permit the steel industry to earn a fair profit; (5) attacks on monopoly, which U. S. Steel is not; (6) socialistic government controls over business; (7) labor-management strife; (8) direct attacks on

business. As he argues for his ideas, Fairless presents strong arguments and evidence, largely from his own experience, occasionally from independent sources.

Fairless seeks to build favorable attitudes toward business, appealing primarily to "thought leaders." He speaks about timely, critical issues. Purpose statements often leave his position unrevealed; collateral theses in many speeches confuse the structure. Transitions are usually adequate, occasionally confusing. His speeches employ three structure-patterns equally: problem-solving, topical, causal. Introductions are often long, yet win attention and good will, and provide background information. Sixty per cent of his speeches end with appeals to decency, sympathy, human dignity, beauty, progress, America, and God. Forty per cent conclude abruptly, almost coldly.

Fairless captures attention by making his issues vital, citing familiar instances, using conflict and humor. He appeals to fundamental wants: preservation, personal welfare, welfare of others. He touches acquisitive and social wants: reputation, leadership, honor, duty, fairness, group acceptance, respect. He pictures business success as the key to national strength. Ethos, too, is a major source of Fairless' persuasion. He has enormous prestige as an industrialist and as a spokesman. His speeches refer to God and religion, the dignity of man. His "common ground" approach, subtle flattery of the audience, modesty, and humor are persuasive.

Fairless' early language was poor; he was understood by about 24 per cent of adult listeners. In April, 1950, his language improved startlingly, probably due to the assistance given him by Phelps Adams, who joined U. S. Steel's public relations team then. Fairless became conversational, his words simple and familiar, clear to most adult listeners.

Fairless is conservative in dress and demeanor. His delivery is characterized by few gestures, pleasant facial expressions, and expressive voice.

How influential was Fairless? Over 60,000 heard him speak and 50,000,000 copies of his speeches were distributed. Many newspapers comment on or agree with his ideas, label him a spokesman, indicate respect for his opinions, reprint his speeches. Fairless represents a minority group, big business, and presents the strongest case he can for business, particularly U. S. Steel. Since competent authorities both support and attack his views, this study does not judge him right or wrong; it summarizes his case and analyzes his speech techniques. Judged by all available evidence, Fairless is an effective spokesman who could hardly expect to win acceptance for all his views on the free enterprise system.

Microfilm \$6.05; Xerox \$21.40. 473 pages.

#### AN ANALYSIS OF VARIANCE OF THE RELATIONSHIP OF EXPERIENCED STAGE FRIGHT TO SELECTED PSYCHOMETRIC INVENTORIES

(L. C. Card No. Mic 58-2787)

Theodore Clevenger, Jr., Ph.D.  
The Florida State University, 1958

This study was undertaken to investigate the relationship of experienced stage fright to total psychological

adjustment, intelligence, manifest anxiety, speech experience, and sex. Previous studies had investigated these relationships individually, but the present investigation was designed to study joint relationships and interaction effects.

Subjects for the experiment were 736 Freshman students enrolled in Speech 105. The Fundamentals of Speech, during the Fall and Spring Semesters of the academic year 1955-56. On the first class day of the semester, each student was asked to complete the Speech Experience Inventory and the Manifest Anxiety Scale in class, and was given an assignment sheet describing a short autobiographical talk due the following class meeting. The sex of each student was established and ACE-T scores and California Test of Personality scores were obtained from the Office of Personnel Records of the University. On the second day of classes, students delivered the short autobiographical talks and immediately afterward completed the Personal Report of Confidence As a Speaker.

Speech Experience Inventory scores, California Test of Personality scores, ACE-T scores, Manifest Anxiety Scale scores, and sex were used as independent, classification variables in establishing a forty-eight cell factorial design, in which Personal Report of Confidence As a Speaker scores (PRCS) served as the dependent or criterion variable. Subjects were classified according to sex, high or low adjustment, high or low anxiety, high or low speech experience, and high, medium, or low intelligence. Since the cell frequencies produced a distinctly non-orthogonal pattern, analysis of variance by estimation of components was the statistical model employed. Tests of significance of difference between means for each of the five main effects and each of the fourteen first-order interaction effects were conducted.

The analysis of variance revealed no significant difference in mean PRCS score for adjustment or for intelligence. A small but significant difference was noted for sex, the women tending to experience more stage fright than the men. Large and highly significant differences were noted for both speech experience and manifest anxiety, the less experienced speakers experiencing more stage fright than the more experienced speakers, and the more anxious speakers experiencing more stage fright than the less anxious speakers.

Significant interactions were noted in only two of the fourteen cases. There was a barely significant interaction between Manifest Anxiety Scale effects and California Test of Personality score effects, manifest anxiety apparently masking out the effects of total adjustment upon experienced stage fright at the higher anxiety levels. There was a highly significant interaction between sex effects and Manifest Anxiety Scale effects, anxiety apparently masking out the effect of sex upon experienced stage fright at the higher anxiety levels. Neither interaction was of the type where direction of differences between means for one variable was reversed for levels of the other variable. Both were of the type where direction of difference remained constant and magnitude of difference was altered.

Microfilm \$2.00; Xerox \$5.60. 114 pages.

THE VOCAL PITCH CHARACTERISTICS  
OF ELEVEN-, THIRTEEN-, AND  
FIFTEEN-YEAR-OLD FEMALE SPEAKERS

(L. C. Card No. Mic 58-2957)

Robert Joseph Duffy, Ph.D.  
State University of Iowa, 1958

Chairman: Professor James F. Curtis

In order to obtain descriptive data concerning the pitch characteristics of adolescent female voices and to explore the possibility of a relationship between changes in pitch characteristics and menarche and/or puberty, 24 female subjects were selected on the basis of chronological age and age of menarche. The four experimental groups consisted of: (1) six females at age eleven who were known to be at least six months prior to menarche; (2) six females at age thirteen who were known to be at least six months prior to menarche; (3) six females at age thirteen who had reached menarche an average of 7.8 months prior to the obtaining of the speech samples; and (4) six females at age fifteen who had reached menarche an average of 33.3 months prior to the obtaining of the speech sample.

A recording was made of each subject reading a standard prose passage. From this recording measures of pitch characteristics were obtained using the standard phonographic method of analysis which had been used in previous studies of pitch characteristics.

Obtained measures of average frequency level and variability were presented and discussed in relation to menarche, puberty, and general vocal development of females as compared to the vocal development of males.

A description was presented of the number, extents, and location of frequency breaks, often termed "voice breaks," which were found in the phonellographic record of all subjects of the present study. These frequency breaks were discussed in relation to female vocal development and were compared to the frequency breaks, or "voice breaks," reported in previous studies.

Using a group of listeners, an attempt was made to match these frequency breaks found in the phonellographic record with certain perceptual phenomena in the recorded speech sample of the subjects of this study.

Microfilm \$2.00; Xerox \$5.20. 104 pages.

A HISTORY OF THE FIRST OLYMPIC THEATRE  
OF ST. LOUIS, MISSOURI, FROM 1866-1879

(L. C. Card No. Mic 58-2970)

Theodore Clark Johnson, Ph.D.  
State University of Iowa, 1958

Chairman: Dr. William R. Reardon

The purpose of this study was to examine the audience, programs, actors, managements and technical methods of production involved in the operation of the Olympic Theatre in St. Louis from 1866-1879.

The major kinds of primary sources used in this study are newspaper reviews and advertisements, theatre programs, city directories and legal records. The kinds of

secondary sources used were histories of St. Louis and Missouri, dissertations of St. Louis theatres and theatre histories, annuals and biographical accounts.

The thesis is organized chronologically into seven periods or chapters each of which is characterized by a change in programming, managerial policy and personnel. During these periods, the Olympic Theatre was a variety and a legitimate theatre with European, southern and local theatrical connections.

In 1866 Moses E. Flanagan owned, managed and financed the building of a theatre which went through an interval of circus and variety programming in which an attempt was made to capture a family audience, followed by one of legitimate drama during which "elite" groups appeared in the audience. Flanagan, although developing a potentially successful business enterprise and a versatile theatre building, failed for lack of capital.

By 1867 Gilbert Spaulding and David Bidwell, experienced and wealthy theatrical managers, with theatrical connections in the United States and in Europe, assumed control of the theatre in which they made major renovations. During this season the technical aspects of production were noteworthy and non-legitimate entertainment was used nearly exclusively. The managers were aggressive and cognizant of the relationship of their programming to their personnel, their audience and their locality.

During the 1868-69 season Spaulding and Bidwell and a stock company of questionable merit failed to program legitimate drama. Non-legitimate entertainment was dominant but interspersed with legitimate drama.

Between 1869-1871 the Olympic Theatre was a part of a circuit controlled by Thomas B. McDonough, Gilbert Spaulding and David Bidwell. Legitimate drama was emphasized but non-legitimate entertainment remained prominent. The stock company was not one of quality, and mention was given to the superiority of the combination.

From 1871-1876, Charles Spaulding, son of Gilbert, and Charles R. Pope managed the Olympic Theatre. Pope purchased one-third interest in the theatre and major building renovations were made. The programming was heavily dominated by legitimate drama, but non-legitimate entertainment was still present. A stock company of excellent quality was used to support the "revered" star, and the technical aspects of production were heavily emphasized. The "elite" of the city and other various audience groups were present and certain behavior patterns were revealed.

The manager of the Olympic Theatre from 1876-1879 was Charles Spaulding who refused to become a member of the "southern circuit" and the Theatrical Managers Association. A stock company, probably of excellent quality, was employed. The programming may have placed greater emphasis on non-legitimate entertainment than in the previous era. Depression, the high salary of stars and possible inefficient organizational methods may have affected the operation of the theatre.

At the outset of the 1879-1880 season Charles Spaulding participated in a "pooling" arrangement with another local theatre. The programs were supported entirely by combinations. In 1882 the first Olympic Theatre was torn down. An era had ended.

Microfilm \$4.55; Xerox \$15.20. 354 pages.

# RECRUITMENT MEASURED BY AUTOMATIC AUDIOMETRY

(L. C. Card No. Mic 58-3696)

Bernard Alter Landes, Ph.D.  
University of Michigan, 1958

Loudness recruitment is the abnormally rapid appreciation of loudness in certain defective ears as the intensity of a given sound is gradually increased. Because this phenomenon has assumed significant clinical and diagnostic importance, many tests have been devised to demonstrate its presence. One such test is automatic audiometry. The width of threshold tracings in automatic audiometry has been taken as a direct indication of the size of the difference limen, a diminishing of which is considered indicative of recruitment. There is reason, however, to consider standard automatic audiometry as controversial, at best, in terms of detection of recruitment.

All previous automatic audiometry has been performed with a standard attenuator which varies intensity logarithmically with time, producing equal decibel changes with equal increments of rotation. Recently, a loudness attenuator was developed which varies intensity so as to produce approximately equal increments in loudness with equal increments of rotation, as based on the normal loudness function of 1000 cps. With such a loudness attenuator available, certain questions concerning the difference in response of normal and recruiting ears to conditions of automatic audiometry involving both the standard and loudness attenuators can be subjected to experimental test.

In this study ten normal ears and twelve recruiting ears were given automatic audiometry tests at seven discrete frequencies under conditions of both attenuators. The tracings thus obtained were measured in terms of the mean width in decibels of threshold excursions. A comparison was made between four sets of data: normal responses to standard automatic audiometry, normal responses to automatic audiometry with the loudness attenuator, experimental (recruiting ears) responses to standard automatic

audiometry, and pathological responses to automatic audiometry with the loudness attenuator.

Analysis of the data by groups revealed that recruiting ears produced narrower threshold excursions at high frequencies than did normal ears under conditions of standard automatic audiometry. This effect was emphasized when the loudness attenuator was used: with the loudness attenuator in the circuit, normal ears produced even wider excursions than formerly, but recruiting ears produced much narrower excursions by comparison. When the normal ears were re-tested in such a way as to induce them to operate through approximately the same range of the output curve of the loudness attenuator as the recruiting ears had used, the difference in width of excursions between the two groups was even more emphasized.

Notwithstanding the significant differences in group means, it proved particularly difficult to assign individual subjects to the normal or recruiting group on the basis of measurements from standard automatic audiometry. The loudness attenuator, on the other hand, provided data on the basis of which such assignment could be made with considerably more confidence. It was shown that defective ears manifest recruitment by a narrowing of threshold tracings from middle to high frequencies, rather than by an absolute diminishing, even in cases in which recruitment could be demonstrated by loudness-balance procedures at low frequencies.

Four general conclusions can be drawn from the study. 1) Taken as a group, recruiting ears give narrower threshold excursions than do normal ears in response to standard automatic audiometry. 2) Notwithstanding significant group differences, it is difficult to separate individual recruiting ears from normal ears on the basis of standard automatic audiometry. 3) The use of the loudness attenuator in automatic audiometry provides a sensitive test of recruitment, using the criterion of a narrowing of threshold excursions from middle to high frequencies. 4) In automatic audiometry, subjects respond to growth of loudness, rather than to DL's. Microfilm \$2.00; Xerox \$5.40. 106 pages.

## ZOOLOGY

# FACTORS AFFECTING APHID TRANSMISSION OF BEAN YELLOW MOSAIC VIRUS

(L. C. Card No. Mic 58-3050)

Warren Clifford Adlerz, Ph.D.  
Oregon State College, 1958

Major Professor: K. G. Swenson

Three experiments were made to determine the effect of different species of plants as virus source plants and as healthy test plants on the transmission of bean yellow mosaic virus by the aphids, *Myzus persicae* (Sulz.) and *Macrosiphum pisi* (Kalt.). Source plants caused significant differences in transmission by both aphids. Broad bean, *Vicia faba* L., was consistently a better virus source plant

than alsike clover, *Trifolium hybridum* L., Alaska pea, *Pisum sativum* L., and Dwarf Horticultural variety, *Phaseolus vulgaris* L.

Three experiments were made to determine the degree of susceptibility of five bean varieties to inoculation of bean yellow mosaic virus by the green peach aphid and the pea aphid. Results were variable for both aphids when the bean varieties Blue Lake, Dwarf Horticultural, Top Crop, Bountiful and Black Valentine were tested.

An experiment was made to determine the effect of age of broad bean source plants on transmission of bean yellow mosaic virus by the green peach aphid. Four broad bean plants were tested every fourth day for 32 days. Transmission was not affected by change in age of the source plants. Individual source plants differed from one another in virus titre.

The different source plants upon which the aphids fed did not affect the average length of acquisition feeding period for the green peach aphid or the pea aphid.

In an experiment concerning the effects of different virus source plants on transmission by the green peach aphid and the pea aphid a higher rate of transmission resulted from replicates run in the morning than from replicates run in the afternoon. In an experiment concerning the effects of different test plants on virus transmission by the green peach aphid and the pea aphid, transmission rates for replicates run in the morning were approximately equal to those for replicates run in the afternoon.

In one experiment, green peach aphids which fed were allowed a naturally terminated acquisition feeding period of 2 minutes or less. An acquisition feeding period of 10-30 seconds was found to be efficient for experimental work.

The green peach aphid was more efficient (28%) than the pea aphid (11%) in all experiments.

Microfilm \$2.00; Xerox \$3.00. 50 pages.

#### THE VERTICAL MIGRATION OF *MYDIS RELICTA* IN LAKES HURON AND MICHIGAN

(L. C. Card No. Mic 58-3635)

Alfred Merle Beeton, Ph.D.  
University of Michigan, 1958

This study had three objectives: (1) to establish the vertical migration pattern of a single zooplankton species, *Mysis relicta* Lovén; (2) to determine, from field data, which environmental factors control this behavior; (3) to determine, through laboratory studies, the way in which these factors exert their influence.

Field work was conducted aboard the U. S. Fish and Wildlife Service's research vessel *Cisco* in 1954 and 1955 in Lake Michigan and in 1956 in Lake Huron. Clarke-Bumpus samplers, half-meter nets, and one-quarter-meter nets, were towed horizontally, to collect plankton. Data were secured on light penetration, temperature, pH, dissolved oxygen, and specific conductance.

During the day mysids could be found only in the two meters above the bottom. In the evening they migrated into the overlying strata as the light intensity decreased from fifteen to one foot-candles. Frequently the mysids migrated through the discontinuity layer, when first ascending, but later in the night the majority occurred immediately below this layer. As the length of day decreased following the summer solstice, the mysids ascended progressively earlier and descended later each night (they descended when the light intensity was increasing from  $10^{-3}$  to  $10^{-2}$  foot-candles). Moonlight and fog influenced the extent and time of vertical migration. Small sexually undifferentiated mysids migrated upward farther than the larger sexually differentiated mysids. Males and females exhibited similar vertical migrations.

Experiments were conducted to determine the response of *M. relicta* to various intensities and wave-lengths of light. The mysid's ability to "dark-adapt" was studied by first subjecting them to an intense light and subsequently observing their response to flashes of light after they had been in total darkness for varying periods of time. They were able to respond to a light intensity of  $9.0 \times 10^{-6}$

foot-candles after nine minutes and forty-five seconds in the dark. The action spectrum for the mysid eye was studied by observing the time required for the mysids to respond to light passing through monochromatic filter combinations. The mysid eye has a maximum sensitivity to light with a wave-length of approximately 515 mu; another peak of sensitivity occurs at or below 405 mu. The phototactic response of *M. relicta* was studied by placing mysids in a glass tube and recording the number of mysids in the unshaded half of the tube after they had been subjected to total darkness or light for several hours. The mysids responded photopositively unless they had been in total darkness for at least ten hours; then they responded photonegatively.

The following conclusions can be made from the study. The vertical distribution of *M. relicta* is governed by light and the existing thermal conditions; pH may exert some influence. Dissolved oxygen and specific conductance definitely did not influence the vertical distribution. Sufficient light at the proper wave-lengths to influence mysid behavior (490 mu to 540 mu) penetrates to depths of at least 100 meters. During the day the mysids are photopositive; however, they are restricted to the stratum immediately above the bottom, since they are forced to retreat to this region by a change in light intensity experienced by swimming upward. As the light intensity decreases at sunset, the mysids migrate into the upper strata due to the positive phototaxis and their subsequent stratification is determined by thermal conditions and occasionally by moonlight. The amount of temperature change was the major factor limiting the vertical movement. During the night the phototactic sign changes from positive to negative. This change is accentuated by an increase in sensitivity to light resulting from dark-adaptation. The dawn descent is due to this photonegative condition.

Microfilm \$2.00; Xerox \$6.80. 143 pages.

#### THE TAXONOMY AND BIONOMICS OF WESTERN *LAEMOPHLOEUS* WITH SPECIAL REFERENCE TO THE STORED PRODUCTS SPECIES (COLEOPTERA-CUCUJIDAE)

(L. C. Card No. Mic 58-3033)

Guy William Bishop, Ph.D.  
State College of Washington, 1958

The western species of *Laemophloeus* have been re-described and a key is given for their separation. Special emphasis is given to the taxonomic characters used in distinguishing the adults and larvae of the three stored products pests, *minutus*, *turcicus*, and *ferrugineus*. The larvae of these three species are described and a key is presented for their separation.

Complete collection records are given for the specimens examined. On the basis of these records, it is indicated that *turcicus* is more common in northern grain-growing areas than *minutus*. It is suggested that the rarity of references to *turcicus* in the literature has resulted from this species being confused with *minutus*.

Relative humidities within the range of 40 to 90 per cent increased the egg production of all three species, and to a lesser degree increased the longevity of the adults.

*L. ferrugineus* was less sensitive to a relative humidity of 40 per cent as indicated by its higher egg production.

Longevity of the adults of the three species was about doubled at 70°F. when compared to 90°F. The marked increase of egg production of *turcicus* at the lower temperature indicates that the optimum temperature for this species may be well over 90°F.

At 90°F., increases in relative humidity reduce the period required for development from egg to adult in all three species. The reduction occurred mostly in the first three larval stadia. *L. ferrugineus* developed at a lower relative humidity than the other two species. Mortality due to low humidities was largely in the first instar.

*L. minutus* was much more sensitive to low temperatures than *turcicus* and *ferrugineus*. The latter two were quite similar in their tolerance. Tests were run at 40°F., 32°F., and 26°F.

None of the species was able to enter perfectly sound kernels of soft winter wheat. However, 30 to 60 per cent of the kernels in samples of soft winter wheat taken from elevators near Pullman, Washington, had flaws in the seed coat of sufficient size to allow the entrance of *Laemophloeus*. The flaws were mostly in the germ area.

The habits of the three species are discussed and compared. Microfilm \$2.00; Xerox \$5.20. 105 pages.

THE ROLE OF THE PITUITARY-ADRENAL  
MECHANISM IN THE REAPPEARANCE OF MELANIN  
AND MELANOPHORES IN THE GOLDFISH,  
*CARASSIUS AURATUS L.*

(Publication No. 22,940)

Walter Chavin, Ph.D.  
New York University, 1954

Adviser: Dr. C. M. Breder, Jr.

A variety of physical and chemical stimuli has been reported to elicit melanogenesis in the goldfish, but the morphological and physiological alterations resulting in such pigmentation remain undescribed. This study was undertaken to determine these changes and the mechanism eliciting them.

Xanthic goldfish exposed to 0.7% increase in salinity became blackened in 2-10 days. Histological examination of series of fish sacrificed at intervals from one hour to nineteen days after such saline increase, revealed altered pituitary cytology, adrenal cortical hypertrophy, and depression of the thyroid epithelial height. After hypophysectomy, however, a similar increase in salinity elicited neither melanogenesis nor histologic change. Evidently, the pituitary or the hormones of the glands under pituitary control, directly or indirectly stimulated the observed formation of melanin.

To determine the hormones responsible for pigmentation, normal and hypophysectomized xanthic goldfish received implants of teleostean pituitary, and fragments of optic lobe, head kidney and opisthonephros; injections of 0.7% saline alone or containing ACTH, ACTH - TSH, intermedin, ACTH - intermedin, adrenal cortical extract, or ACTH - adrenal cortical extract; injections of ACTH or intermedin in gelatin, or gelatin vehicle alone.

In hypophysectomized goldfish, the results indicated a direct correlation between melanization and experimental treatment with teleostean pituitary or mammalian ACTH. Normal fish were blackened only with pituitary implants or ACTH in gelatin. As both the level of gonadal development and the thyroid epithelial height were variable in the melanized goldfish, the pituitary hormones stimulating these glands and the secretions of these glands appeared unlikely as factors in the observed melanogenesis. Neither implantation of head kidney containing adrenal tissue, nor injection of adrenal cortical extract blackened the experimental animals, thus indicating that the secretion of the adrenal cortical tissue was not responsible for the appearance of melanophores. The extra-adrenal action of the pituitary factor, ACTH, is evidently responsible for the observed melanogenesis in the goldfish.

The interrenal cells of the goldfish anterior interrenal tissue were atrophied after hypophysectomy and reacted in a manner comparable with the mammalian adrenal cortical cells to ACTH and the various other stimuli described above, thus confirming the previous suggestions concerning their homology. The interrenal cell hypertrophy and the induction of melanophores in the yellow goldfish occurred after ACTH administration but not after intermedin at any dosage level used. These two pituitary factors are not the same hormone as has been postulated.

Degeneration of the lipophores of the xanthic goldfish after hypophysectomy indicated that the pituitary was necessary for lipophore maintenance. Hypophysectomy was reduced to a 4 to 5 minute operation, with a mortality of less than 10%, by development of a simple technique described herein.

Microfilm \$2.00; Xerox \$6.20. 128 pages. Mic 58-5081.

MATERNAL-OOCYTE RELATIONSHIPS IN  
THE FROG, *RANA PIPIENS*, AS REVEALED  
BY FLUORESCIN LABELLED ANTIBODY

(L. C. Card No. Mic 58-2733)

Laurel Ellen Glass, Ph.D.  
Duke University, 1958

Supervisor: George W. Nace

Schechtman has hypothesized that the transfer of large molecules from the maternal serum into the oocyte or fetus plays a significant role in the normal development of many animal forms. The immunocytological study reported here, analyzing the intracellular location of macromolecules with serum-like reactive groups in frog oocytes, was designed to examine Schechtman's hypothesis in relation to amphibian oogenesis.

Rabbit antisera were prepared against the following tissues of *Rana pipiens*: adult female frog serum (AFS), adult male serum, adult male kidney and the homogenization supernatant from unovulated ovaries (large oocyte supernatant or LOS). AFS absorbed and LOS absorbed fractions of antiserum against female frog serum were prepared and an anti-Human Tumor serum was utilized. After characterization by interface precipitin and agar diffusion tests,  $\gamma$ -globulin fractions of these antisera were conjugated with fluorescein isocyanate. The various conjugated antisera and conjugated normal rabbit serum were

used extensively as histochemical stains on paraffin embedded and frozen ovarian sections containing oocytes at all stages of growth. In combination, results obtained with these antisera demonstrate the immunocytological specificity of the fluorescent localizations observed. Each antiserum showed a characteristic localization and intensity of fluorescence which was different from that of the antisera directed against other antigens.

In oocytes reacted with conjugated antiserum to adult female frog serum, cytoplasmic fluorescence was brightest in prevolk cells although there was bright fluorescence of peripheral masses and of yolk nuclei in oocytes in early and middle stages of yolk deposition. Small, non-fluorescent yolk granules were embedded in a fluorescent matrix in the older oocytes and the surface of the large yolk platelets fluoresced brightly. During oocyte growth the nucleoplasm fluoresced dimly but nucleoli were non-fluorescent until very late in vitellogenesis. Folliclethecal fluorescence, initially very slight, increased steadily during oocyte growth and reached its highest intensity around eggs which were nearly mature.

Conjugated antiserum against large oocyte supernatant was localized mainly in and around the yolk platelets and their sites of formation. Nucleoli were fluorescent in most oocytes undergoing yolk deposition but were non-fluorescent in pre-yolk oocytes and in some mature oocytes. Low intensity fluorescence was observed in cells of the folliclethecal complex.

Electrophoretic analyses of female serum showed changes in the serum proportions of certain components which might correlate with the growth cycle of ovarian oocytes.

It is concluded that localizations of fluorescent antibodies against adult female frog serum represent the intra-oocyte positions of large molecules with combining groups similar to or identical with those in maternal serum. It is hypothesized that at least part of such oocyte antigens are macromolecular components transferred intact, or nearly so, from the maternal serum through the follicle-thecal cells and into the oocyte. It is hypothesized further that these are utilized as substrate and/or enzymes and/or coenzymes during yolk deposition in the frog.

Microfilm \$3.10; Xerox \$10.60. 238 pages.

#### CARBON DIOXIDE METABOLISM OF THE OYSTER MANTLE

(L. C. Card No. Mic 58-2734)

Carl Schlee Hammen, Ph.D.  
Duke University, 1958

Supervisor: Karl M. Wilbur

Carbon dioxide metabolism of the mantle tissue of the oyster, *Crassostrea virginica*, was studied with the use of carbon-14, and the techniques of paper chromatography, Warburg manometry, and kinetic spectrophotometry.

Oysters placed in sea water containing C-14 bicarbonate incorporated the isotope into both the calcium carbonate and the organic portions of their shells. Isolated mantle tissue incubated in sea water with added C-14 bicarbonate incorporated the isotope into three fractions of organic

material, an ether-soluble, an aqueous ethanol-soluble, and an acid-insoluble fraction. The specific activity of all fractions increased with time of incubation, and the curves relating specific activity to time suggested synthesis of labeled protein from labeled amino acids.

Mantle homogenates rapidly decarboxylated oxalacetic acid; the manometric determination of enzymatic activity indicated an optimum in the vicinity of pH 4.7, approximately equal stimulation by manganese and magnesium ions, and no stimulation by ITP or TPN. Decarboxylation in the presence of C<sup>14</sup>O<sub>2</sub> followed by isolation and separation of substrate and product indicated that the enzymatic reaction was essentially irreversible, and that the product was pyruvate just as in the non-enzymatic breakdown of oxalacetic acid. It was concluded that the enzyme does not resemble any known enzyme capable of CO<sub>2</sub> fixation, and could not account for uptake of C-14 into fractions as described above.

Evidence for the presence of a malic enzyme which oxidatively decarboxylates malic acid to pyruvate and CO<sub>2</sub> was found in the supernatant part of centrifuged mantle homogenates. Malic acid-induced reduction of TPN was reversed temporarily by addition of pyruvate and bicarbonate. But more complete reversal was obtained with addition of oxalacetic acid, indicating that a malic dehydrogenase of the Krebs cycle was producing most of the TPN reduction rather than a malic enzyme which could catalyze CO<sub>2</sub> fixation.

Fresh mantle tissue was extracted for organic acids and free amino acids, which were separated and identified by paper chromatography. Eight organic acids were found: succinic, fumaric, malic, citric, ketoglutaric, pyruvic, lactic, and an unidentified acid. Succinic, lactic, and the unknown acid were far more abundant than the others. Five free amino acids were identified: alanine, asparagine, aspartic and glutamic acids and serine.

Isolated mantle tissue was incubated for 1.5, 6, and 60 minutes in sea water with C-14 bicarbonate, and the organic acids were extracted and chromatographed, in some cases with known acids added as carrier. Succinic, fumaric, and malic acids and no others were radioactively labeled; succinic acid contained 90 per cent or more of the radioactivity found in organic acids in all periods of incubation, and became just as highly labeled when the tissue was incubated under anaerobic conditions. Aspartic and glutamic acids, and alanine, were labeled in 10 minutes of incubation; aspartic acid contained 90 per cent of the radioactivity found in amino acids.

When whole oysters were placed in sea water with succinic-1-C<sup>14</sup> acid for 18 hours the mantle tissue of these animals contained labeled succinic, fumaric, and malic acids, at least two unidentified labeled substances, and accumulated labeled threonine and serine. This demonstrated the utilization of succinic acid by whole oysters and alteration of tissue levels of free amino acids as a result.

Isolated mantle tissue was provided with Na-1-C<sup>14</sup> propionate in the medium. The pattern of extracted organic acid and free amino acid labeling was very similar to that found when C-14 bicarbonate was provided. This confirmed previous indications that the primary CO<sub>2</sub> fixation reaction in the oyster mantle is the carboxylation of propionic acid to form succinic acid.

The results of this investigation revealed that carbon dioxide is of considerable metabolic importance in the

oyster mantle. It may contribute to shell carbonate, and via the citric acid cycle, to the synthesis of a variety of organic compounds, including in all probability the conchiolin of shell and the glycogen reserves of the mantle.

Microfilm \$2.00; Xerox \$3.60. 61 pages.

**SOME HYPOPLASTIC MODIFICATIONS OF THE  
TELENCEPHALON FOLLOWING UNILATERAL  
EXCISION OF THE NASAL PLACODE  
IN RANA PIPIENS EMBRYOS**

(L. C. Card No. Mic 58-2964)

Joseph Leroy Harrison, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Jerry J. Kollros

The developmental relationship between the nasal organ and the telencephalon of *Rana pipiens* was studied. The nasal placode was excised at stages 18, 19 and 20, and animals so operated were fixed at embryonic stages 23, 23+, 24 and 25, while larvae were fixed at stages I, V, X, XV, XX and XXV. Unoperated controls were fixed at each of the above stages; however, the contralateral cerebral hemispheres of the experimental animals served as controls. Unilateral excision of a nasal placode initiates a hypoplasia and/or hypotrophy of the ipsilateral cerebral hemisphere. This condition develops progressively with time in such a manner that the cerebral hemisphere on the experimental side is, on the average, 94% as large as the one on the control side at stage 23, 83% as large as stage I and 72% as large at stage XXV (at the end of metamorphosis). The affected forebrain is hypoplastic at all levels, with a greater defect evidenced at anterior levels than at posterior ones, but significantly at both levels. This reduction involves both the central gray and superficial white matter. The olfactory glomeruli and the lateral forebrain tract fail to develop. Nuclear, and probably cell sizes, at least in selected areas, are significantly reduced. Pycnotic nuclei are observed in both cerebral hemispheres of the stage XX and XXV animals, but at stage XXV there is a significant excess of these on the operated side. On the average there are fewer mitotic figures on the experimental side than on the opposite side. This condition develops gradually with time in such a manner that there are on the experimental side, 88% as many such figures as on the control side at stage I, 82% at stage X and 80% at stage XXV (at the end of metamorphosis). The subnormal size of the affected cerebral hemisphere is thus attained by a combination of factors - a reduced rate of cell production, and locally, at least, enhanced cell loss, and deficient cell growth.

Microfilm \$2.00; Xerox \$3.00. 50 pages.

**DIFFERENTIATION OF FIRST- AND SECOND-SET  
GRAFTS OF EMBRYONIC, NEONATAL AND  
ADULT TESTIS IMPLANTED BENEATH THE  
KIDNEY CAPSULE OF ADULT RAT HOSTS**

(L. C. Card No. Mic 58-3677)

Jeanne Ruth Holden, Ph.D.  
University of Michigan, 1958

Homoplastic single implants of adult, neonatal, or embryonic testis were grown in the kidney capsule of adult white rats for periods of 2, 4, 6, and 8 weeks. One neonatal implant was allowed to grow for 29 weeks. In addition, double implants of testis in the following age combinations were grown in the kidney capsule: adult-adult, embryonic-adult, adult-embryonic, embryonic-embryonic, adult-neonatal, neonatal-neonatal, and embryonic-neonatal. The first implants in these latter experiments were 2 weeks old when the second implants were made, and the hosts were autopsied and both grafts recovered 2 weeks later.

Few single implants of adult testis were recovered. In these the seminiferous tubules were collapsed and cells had degenerated. Connective tissue proliferation and breakdown of renal tubules was observed at the graft sites. Single neonatal grafts exhibited marked cellular degeneration at 2 weeks. Sloughing and resorption of degenerated cells was evident in neonatal grafts after 4 and 6 weeks. Connective tissue proliferation between the seminiferous tubules was evident at 4 weeks and increased progressively up to 8 weeks. Evidently by 8 weeks a new wave of proliferation had started, for mitosis and accompanying pycnosis of differentiating cells were again in progress. The 29-week implant was healthy but its tubules contained only spermatogonia and perhaps Sertoli cells. Single embryonic implants were healthy at 2 weeks, but exhibited cellular pycnosis at 4 weeks. Sloughing of cellular debris into the lumens of seminiferous tubules was apparent at 4 and 6 weeks. By 8 weeks there was evidence that spermatogonia were dividing and differentiating again.

Experiments with double implants indicate that first implants were not affected by the presence of a second graft; neither were second grafts of embryonic tissue affected by first grafts. On the other hand, second implants of neonatal testis were definitely affected by a previous implant. Furthermore, a second implant might affect the host kidney more than the first implant, a result obtained in the adult-adult combination of first and second grafts. Second neonatal implants were retarded in development regardless of whether the first implant was from embryonic, neonatal, or adult donors. This indicates that all three ages share similar antigens. Although temperature of the body cavity is probably a factor in the development of implanted testis, evidence is strong that immunity actively acquired as a reaction to the first graft caused retardation of second neonatal grafts. Since vascularization and growth of second neonatal implants were good, it is postulated that host antibodies inhibited the proteins necessary for the differentiation of seminiferous tubules in second grafts of neonatal gonads.

Microfilm \$2.00; Xerox \$6.40. 131 pages.

# AN ECOLOGICAL STUDY OF THE RECENT OSTRACODS OF THE GULF COAST OF FLORIDA

(L. C. Card No. Mic 58-2791)

Neil C. Hulings, Ph.D.  
The Florida State University, 1958

Three major areas were sampled for ostracods on the Gulf coast of central Florida during 1956 and 1957. The areas included Ochlockonee Bay, a neutral estuary, Apalachee Bay, designated as the inner neritic zone, and an offshore transect from Panama City to St. Petersburg, designated as the outer neritic zone. Ochlockonee Bay represents a typical brackish-water environment. The hydrography of Apalachee Bay is influenced by estuarine discharge and encroachment of high salinity water from the Gulf of Mexico. The outer neritic zone is a more normal marine environment.

A total of 165 bottom samples, collected by use of the Petersen grab, were analyzed for ostracods. Fifty-four samples were taken in Ochlockonee Bay, 87 in Apalachee Bay and 24 in the outer neritic zone. A total of 83 species was encountered in the three areas, 47 of which have been positively identified. The distribution of species is broken down as follows: Ochlockonee Bay - 26 species with 11 limited to the bay; Apalachee Bay - 56 species with 13 restricted to Apalachee Bay; the outer neritic zone - 47 species with 14 found only in this zone.

In each of the three areas, various biozones were established on the basis of the generic and specific composition of the living ostracods and on the type of substratum. An upper bay biozone and a lower bay biozone were established in Ochlockonee Bay. In Apalachee Bay, three biozones were established: sandy, muddy sand and grass flat. The biozones established in the outer neritic zone were carbonate, sandy and gravel. Each of these biozones with the exception of the gravel yielded diagnostic ostracod genera and species. Certain ostracod genera and species in each of the three major collecting areas were found to have rather restricted salinity, temperature and depth ranges.

The ostracod fauna of the inner and outer neritic zones of the Gulf coast of central Florida appears to be similar to that of the Florida Bay region and to the Miocene and post-Miocene fauna of the Gulf Coastal Plain. The ostracod fauna of Ochlockonee Bay is similar to that of San Antonio Bay in Texas. Microfilm \$2.90; Xerox \$10.00. 224 pages.

# SYSTEMATICS OF LARVAL APHODIINAE WITH NOTES ON THE BIOLOGIES OF SEVERAL SPECIES (COLEOPTERA: SCARABAEIDAE)

(L. C. Card No. Mic 58-3054)

Manohar Lal Jerath, Ph.D.  
Oregon State College, 1958

Major Professor: Paul O. Ritcher

Larvae of the coprophagous scarabaeid subfamily Aphodiinae have been rather neglected in the past due to their uneconomic importance and small size. In this paper 41 species belonging to four tribes and nine genera are

described in detail. These genera are Aegialia, Aphodius, Oxyomus, Saprosites, Aphotaenius, Euparia, Ataenius, Psammodytes and Pleurophorus. The subfamily together with its tribes and genera are characterized and keys for separating tribes, genera and species are presented, using the structures of the epipharynx, maxillae, raster and lower anal lobes. Larvae of Aegialia, Aphotaenius, Euparia and Pleurophorus are described here for the first time.

Brief biological information for Aegialia spp., Aphodius spp. and Psammodytes oregonensis is given. It was found that in Oregon, Aegialia spp. and most species of Aphodius have one generation a year; A. vittatus has two generations a year. Adults of Aegialia, Aphodius fimetarius, Aphodius vittatus, Aphodius granarius and mature third-stage larvae of Aphodius sparsus and Aphodius aleutus overwinter in Oregon. Larvae of most species of Aphodiini feed on dung, although larvae of eight species of Aphodius feed on the roots of living plants. Larvae of Aphodius hamatus and A. distinctus are recorded as injurious to plants for the first time. Adults and larvae of Aegialia spp. and Psammodytes oregonensis were found in sandy areas near the coastal beaches. Aegialia spp. were also collected in the sandy areas along the inland streams. Adults were found all the year round.

Distribution data of Oregon species is presented. In Oregon, six species of Aegialia, thirty-three species of Aphodius, two species of Psammodytes and one species of Pleurophorus are recorded. Four species of Aegialia and fifteen species of Aphodius are recorded from Oregon for the first time.

On the basis of larval characters, species included in the subfamily Aegialiinae by many authors, are now included under the subfamily Aphodiinae in a tribe Aegialiini. In the tribe Eupariini, larvae of Saprosites and Aphotaenius belong in one group and larvae of Euparia and Ataenius belong in another group on the basis of setation on the frons, clypeus and raster. Unlike most other scarabaeid larvae, the larvae of Psammodytes and Pleurophorus of the tribe Psammodytini and Saprosites of the tribe Eupariini lack stridulatory teeth on the stipes.

Microfilm \$2.25; Xerox \$7.80. 169 pages.

# THE GRAYLING OF GREBE LAKE YELLOWSTONE NATIONAL PARK, WYOMING

(L. C. Card No. Mic 58-3693)

Thomas Eugene Kruse, Ph.D.  
University of Michigan, 1958

This was a study of certain features of the grayling population in Grebe Lake fundamental to its management as a recreational resource. Field work was done in the summers of 1952, 1953, and 1954.

Grebe Lake is a eutrophic body of water described as follows: elevation, 8,000 feet; area, 145 acres; maximum depth, 32 feet; ice covered, about 6 1/2 months annually; highest surface temperature recorded, 67°F.; predominant insects by volume and number, Tendipedidae (=Chironomidae) larvae and pupae. By July 14, 1953, an oxygen deficiency in the waters below 20 feet made them unsuitable for fish life. The grayling was introduced in

1921. Rainbow trout were planted in 1907; cutthroat trout in 1912 (only hybrid trout are present now).

Population estimates in 1953 and 1954 utilized trap nets and a mark-and-recapture method. There were approximately 28,000 grayling in the lake in 1953 and 27,000 in 1954. A population of hybrid trout was estimated at 2,000 in 1953 and 2,500 in 1954. The standing crop of fish in Grebe Lake each year approximated 81 pounds per acre of which 73 pounds per acre were grayling and 8 pounds per acre were trout.

Both the grayling and the hybrid trout spawned in all four tributaries and the Outlet of Grebe Lake between mid-May and late June. The number of grayling spawning in 1953 was 7,081 and in 1954, 7,878. Enumeration of the trout at the same times showed 674 and 405 respectively.

During 1954 the natural fry production of grayling in the tributaries of the lake was estimated as 236,500 or 2.5 percent of the estimated number of eggs produced by the spawning adults. The greatest cause of mortality during the early developmental period was attributed to dislodgment of the eggs either by subsequent spawners or by changes in water level.

The time of annulus formation for grayling younger than 3 years was prior to June 25. Accurate interpretations of age from scales of grayling after their third year was impossible because of the small annual growth both in body and scale lengths. An additional complication often resulted from an absence of a scale annulus to designate the first year of life. This occurred on fish that were too small to have had scales at the start of their second growing season. The grayling reached the legal size of 6 inches during its second summer of life and matured during its third year of life.

The hybrid trout grew more slowly than the grayling during its first three years of life but more rapidly after age 3. The legal size (6 inches) was attained either in the second or third year of life. Some males of age-group II had matured, but no females matured until they were 3-year-olds.

Neither the grayling nor the trout was predatory. The food of the grayling during its first year of life consisted of small nymphs of aquatic insects, amphipods, and *Daphnia*. The major item in the diets of adults of both kinds of fishes was found to be dipterous larvae and pupae.

Fishing pressure on Grebe Lake was light with a harvest of only 7.1 percent of the estimated population or 6 pounds per acre in 1953, and 9.9 percent or 8 pounds per acre in 1954.

The combined mortality from anglers and predators in 1954 approximated 4,200 fish or 14.2 percent of the estimated adult population of 29,500 fish.

Microfilm \$2.00; Xerox \$7.00. 150 pages.

#### STUDIES ON THE SCHOOLING BEHAVIOR OF THE MINNOWS, *SEMOTILUS* AND *RHINICHTHYS*

(L. C. Card No. Mic 58-3694)

Robert Andrew Kuehne, Ph.D.  
University of Michigan, 1958

As an interesting type of vertebrate society, the fish school has received considerable attention from students of behavior during the past thirty years.

My primary goal in this thesis is to gain an understanding of the schooling habits of the stream minnows, *Semotilus atromaculatus* (Mitchill), and *Rhinichthys atratulus* (Hermann). The information so gained is related to other studies of schooling. Finally, an explanation of the origin and utility of schooling behavior is proposed.

*Semotilus* and *Rhinichthys* form loosely-knit schools, often composed of these and other minnow species. Groups of small fish (less than 50 mm) remain apart from schools of larger, older specimens. Aggregations are active during summer and fall but not in winter. Spring spawning tends to disrupt schooling.

Single fish placed in an observation tank avoided intense illumination and preferred dark background. They were attracted to stationary objects in the tank, hiding beneath them when possible. Presented with a depth gradient, a disturbed fish preferred the deepest water. Two or more fish formed a school, and such groups reacted to environmental conditions in the same way as single fish. However, group integration improved as greater numbers were involved.

Blinded fish did not school and swam more slowly and steadily than normal fish.

Photography of groups of *Rhinichthys* showed that spacing and swimming speeds are variable. Lead fish tended to swim more erratic paths and thus greater distances than all succeeding individuals in the school. Leadership alternated among fish in the group.

Individuals of both species were given visual preference tests to evaluate the effects of number, shape, size, and movement on schooling. All fish preferred large rather than small numbers of their own species. Preference for fish of nearly the same size was noted. Species recognition and shape preference were not highly developed. Both species were attracted to active rather than to sluggish fish. It is suggested that responsiveness to movement is a basic mechanism involved in schooling of *Rhinichthys* and *Semotilus* and that other visual preferences may develop from it. No evidence could be obtained for the use of any sense other than sight in the schooling reaction of these minnows.

Both species behave like blinded fish at light intensities below 1.35 luxes (1 lux = 0.0929 foot candles). Group interaction appears and develops to its maximum between 1.35 and 6.70 luxes.

The schooling habit seems to aid *Semotilus* and *Rhinichthys* in orientation, feeding, and predator avoidance. These proposed benefits are considered for possible application to other schooling studies.

An explanation of the origin and utility of schooling behavior is presented. The basis of the behavior is considered to be an innate attraction of young fish toward moving objects. The value and degree of expression of the behavior is dependent primarily on the type of environment. Streams, lakes, and pelagic, marine areas are used as examples of habitats in which schooling is found to differing degrees. The possible use of senses other than vision in achieving schooling are mentioned.

Microfilm \$2.00; Xerox \$4.40. 85 pages.

RESTITUTION OF THE TELENCEPHALON  
FOLLOWING UNILATERAL EXCISION  
IN EMBRYOS OF *RANA PIPIENS*

(L. C. Card No. Mic 58-2978)

Willie F. Payne, Ph.D.  
State University of Iowa, 1958

Chairman: Professor Jerry J. Kollros

The regenerative capacity of the embryonic telencephalon in *Rana pipiens* was investigated. The lateral half of the telencephalon was removed at various embryonic stages (Shumway's stages 16, 18, 20, 23 and 25). Operated animals were fixed and sectioned 12-24 hours after operation in order to observe the extent of the operation and the early phases of regeneration. Other animals were fixed 2, 3, 5, 9, 13 and 15 days following operation in one group, and 10, 30 and 60 days following operation in a second group. In this second group operations included the excision of the rostral one-third or the caudal one-third of a lateral half of the telencephalon. Regenerative capacity was studied by making mitotic counts, ventricular surface measurements and planimetric measurements of volume.

After complete and partial excision of the telencephalon, complete or nearly complete morphological restitution may follow. Regeneration begins by the formation of a thin lamina of cells migrating from the roof and floor plates of the intact side. This lamina of cells apparently is the main source of the proliferative cells which reconstitute the missing part. An analysis of the total number of mitoses shows, in general, the intact side has the greater number of mitotic figures. During the first two days, the dorsal half of the telencephalon shows more dividing cells. After this period, the greater number of dividing cells is located ventrally. Mitotic activity, based on the number of dividing cells per unit of ventricular surface, reaches a maximum, on both sides, between the fifth and ninth days. A decrease follows this period. The mitotic density, however, remains much higher on the operated side than on the intact side. In earlier periods (2-3 days) the intact side has significantly more mitoses than the operated side. After the fifth day, the total number of mitoses on the two sides does not differ statistically. The number of mitotic figures per unit volume is greater, in general, on the operated side. The ependymal mitoses assume the major role in the restorative process. Extra-ependymal cells also contribute, but their contribution declines as the animals grow older. The greater number of mitoses is present in the posterior half of the telencephalon. The degree of restitution generally is increased with time following the operation. Complete or nearly complete restitution occurred for some individual animals in each of the stages used at the time of operation. The regenerated side appears histologically complete except for pronounced reduction in the size of the olfactory glomerulus.

Microfilm \$2.00; Xerox \$4.60. 90 pages.

A REVISION AND VARIATION ANALYSIS OF  
*EUPARYPHUS* AND RELATED GENERA  
(STRATIOMYIDAE: DIPTERA)

(L. C. Card No. Mic 58-3045)

John A. Quist, Ph.D.  
State College of Washington, 1958

The traditional taxonomic approach used in this revisional study and variation analysis of *Euparyphus* and related forms has been augmented by a study of the male genitalia, and the variation analysis is presented in its taxonomic implications rather than with special treatments. A key is presented to the New World genera of the tribe Hermionini.

The heterogenous genus *Euparyphus* is shown to be comprised of several taxa. *Caloparyphus*, formerly a subgenus, has been elevated to full generic status, and is considered more primitive in its phylogenetic relations, with definite affinities to palearctic groups. Probably in the wake of glacial recession its species have become distributed over the North American continent. Three natural species groups are recognized in *Caloparyphus*, with *C. decem-maculatus*, a species described from a unique, the type of which is lost, carried separately. The *tetraspilus* group of species including *C. tetraspilus* Loew, *C. atriventris* Coquillett, *C. greylockensis* Johnson, and *C. n. sp.* Vockeroth manuscript represent the new additions to the genus. *C. obliquus* Hine and *C. adaleonora* Steyskal are reduced to synonymy.

The genus *Euparyphus* is recognized as comprising *Euparyphus*, *sensu stricto*, and three subgenera, *E. (Aochletus)* Osten Sacken, *E. (Parochletus)* new subgenus, and *E. (Nigriparyphus)* new subgenus. This genus and its subgenera, which have bifid aedeagi, are shown to have neotropical affinities, and their species appear to be recently evolved, perhaps since the beginning of Pleistocene. *Euparyphus*, *sensu stricto*, contains species which are variable and difficult to name. Two formerly nominal species, *vanduzeei* James and *latelimbatus* Curran have been reduced to subspecies of *mutabilis* Adams, and *nigrostigma* Curran has been made a synonym of *stigmatalis* Loew.

The genus *Aochletus* Osten Sacken has been reduced to a subgenus of *Euparyphus* and two North American species recognized; *cinctus* Osten Sacken occurs in Mexico and the western United States, and *brevicornis* Loew occurs in the eastern states and Canada. *Euparyphus brucensis* Steyskal is a synonym of *E. (Aochletus) brevicornis* Loew.

*E. (Parochletus)*, new subgenus, has been erected to receive those small species of *Euparyphus* which are intermediate between *Aochletus* and *Euparyphus*. Three species are referred to *E. (Parochletus)*: *pardalinus* James, *sabroskyi* James, and *carbonarius* Giglio-Tos.

The subgenus *E. (Nigriparyphus)* was erected to include, besides *ornatus* Williston, five new species: *proxipalus*, the type species of the subgenus, *paludicola*, *umbrulus*, *catractus* and *patagius*.

Microfilm \$2.00; Xerox \$5.20. 104 pages.

AN ECOLOGICAL STUDY OF THE DESERT  
SPIDER MITE TETRANYCHUS DESERTORUM  
BANKS ON COTTON

(L. C. Card No. Mic 58-2835)

Byron Colman Smith, Ph.D.  
University of Georgia, 1958

Major Professor: H. O. Lund

During the summer of 1955 a survey of the major cotton producing regions of Georgia was conducted to determine the species of mites of the genus Tetranychus occurring on cotton and their distribution over the state. Eighty and six-tenths per cent of the spider mites identified in this study were T. desertorum with T. telarius comprising only 12.9% of the total. The survey revealed three other species involved in spider mite infestations; T. schoenei 2.6%, T. atlanticus 1.9%, and T. cinnabarinus 1.9%. No definite pattern of species distribution could be determined in Georgia.

An examination of 180 samples of cotton leaves taken from three levels of plant height indicated no significant selection of position on the plant by the mite, although total population counts were highest in the middle one-third. Eggs are generally deposited along the leaf veins but no significant preference of position was shown by the mites.

Five stages in severity of leaf damage were established, recognizable by alterations in leaf texture and coloration. Highly significant variations in spider mite populations occurring on various stages of leaf damage probably depends upon both damage brought about by mite feeding and, indirectly, the habitat now available for subsequent mite progeny.

The reproductive rate of spider mites decreases considerably throughout the winter months. The failure to establish equal sex ratios at low winter population levels in these mites having haploid males indicates that a sufficient number of male mites is available to fecundate the females.

The mite infestations usually spread with greatest rapidity in regions where interlacing branches of the cotton plants occurred. Field experiments indicated that no valid differences existed among the four varieties (Auburn, Delta Pine, Empire, Plains) of cotton tested as to mite susceptibility. A rain may be destructive to a mite population but may distribute the mites in streamlets. One of the most important factors influencing the growth of spider mite populations is the relative humidity-temperature relationship under the cotton plant cover.

It is apparent from our experiments that adult coccinellids are quite capable of spider mite predation to an extent that is significant in spider mite control. However, the adverse effects of organic insecticides on insect predators of spider mites considerably reduced their effectiveness as biological control agents.

In August 1955, a field experiment was begun to determine the degree and duration of effectiveness of seven chemicals applied as acaricides. Simple inspection of the results is sufficient to indicate that there was no significant difference in either the degree or the duration of effectiveness among the seven chemical dusts applied. With but one exception, the first count following the initial chemical application, the check counts followed the general spider mite population decline.

In the field clean cultivation practices during the winter and spring as well as throughout the active growing season of cotton will be beneficial in the reduction of potential spider mite populations.

Microfilm \$2.35; Xerox \$8.20. 178 pages.

FURTHER INVESTIGATIONS OF THE GROWTH  
REQUIREMENTS OF PARAMECIUM AURELIA,  
VARIETY 4, STOCK 51, SENSITIVE

(L. C. Card No. Mic 58-2941)

Vincent Alfred Tarantola, Ph.D.  
Indiana University, 1958

A method has been developed for the fractionation of an acetone insoluble preparation from baker's yeast required for the axenic growth of Paramecium aurelia, variety 4, stock 51, serotype A, sensitive. The procedure involves extraction under mild conditions with trichloroacetic acid, perchloric acid, and a mixture of sodium carbonate plus sodium bicarbonate.

Of the acid and alkali soluble fractions, only the material removed by perchloric acid was found to be essential for growth. This fraction could be further purified by precipitation with an equal volume of cold ethanol. Chemical analysis of the material soluble in acid and alcohol demonstrated that the bulk of the fraction was comprised of nucleic acid. Subsequently, it was found that this crude soluble fraction could be effectively replaced by a known mixture of ribosides or ribotides. The deoxyribosides promoted slight growth while the free purine and pyrimidine bases were inert.

Analysis of the minimal nucleic acid requirement showed that a purine and a pyrimidine derivative were essential for continued growth. The requirement for a guanine ribosidic derivative was absolute. All the adenine derivatives tested were found to be inhibitory at one or more of the concentrations employed. Sparing of the purine requirement occurred in the presence of the following compounds, in their order of activity: deoxyguanosine, adenylic acid, inosine, xanthosine, and guanine. The pyrimidine requirement was met by ribosidic derivatives of cytosine or uracil. Deoxycytidine, uridine, uridylic acid, deoxyuridine, thymidine, thymine, and uracil were found to spare the pyrimidine requirement in that order of activity.

Under the assay condition employed, combinations of the minimal essential purine and pyrimidine ribosides had more activity than the corresponding combinations of ribotides. Maximal growth responses in the presence of the essential ribosides or ribotides were obtained when the purine:pyrimidine molar ratio was approximately 0.4. An hypothesis of inhibition of pyrimidine metabolism by adenine and its derivatives has been proposed to account for the effectiveness of the stated molar ratio.

The crude material insoluble in acid and alkali was also found to be essential for growth. This fraction has been characterized by an extreme lability to alkali and acid at elevated temperatures. In addition, the fraction loses all activity after proteolytic digestion. Restoration of activity by proteose peptone suggests that a peptide is one of the essential factors supplied by this crude fraction.

Microfilm \$2.00; Xerox \$4.40. 84 pages.

THE LIFE HISTORY OF *FIBRICOLA CRATERA*  
(BARKER AND NOLL, 1915) DUBOIS 1932  
(TREMATODA: DIPLOSTOMATIDAE)

(L. C. Card No. Mic 58-3022)

Henry Ford Turner, Ph.D.  
Iowa State College, 1958

Supervisor: Martin J. Ulmer

All stages in the life history of *Fibricola cratera*, a diplostomatid fluke parasitizing the small intestine of the raccoon and other mammals, were experimentally demonstrated in the laboratory.

Large, dark amber, operculate eggs are voided with the feces from experimentally-infected hosts within six to eight days after infection. Under laboratory conditions, considerable variation exists as to the length of time involved before miracidia emerge from eggs. During summer months eggs hatch in as little as nine days or as long as 33 days following their appearance in the feces. Miracidia are similar in appearance to those of other species of *Fibricola*. The epidermal plate formula is 6:9:4:3. Two pairs of flame cells occur.

Two generations of sporocysts develop following penetration of miracidia into the snail, *Physa gyrina* Say. Mother sporocysts develop in the mantles of these molluscan hosts and give rise to numerous daughter sporocysts which migrate to the digestive gland. The long, sac-like mother sporocysts possess an anterior, sub-terminal birth pore. Daughter sporocysts resemble mother sporocysts in general appearance but differ in that they are more threadlike, exhibit greater motility and show less opacity.

Furcocercous cercariae emerge in 24 to 31 days under laboratory conditions during summer months. They possess two pairs of penetration glands anterior to the acetabulum. Their flame cell formula is  $2(1 + 1 + 1) + (1 + 1 + (1)) = 12$ . When undisturbed, cercariae hang body downward in the water with tail furcae spread widely apart. They appear to be definitely attracted to and quickly penetrate into young tadpoles of several kinds, especially *Rana pipiens*.

Metacercariae (diplostomula) develop in the peritoneal coelom of tadpoles and acquire in a relatively short time all structures associated with the adult worms except those of the reproductive system. In tadpoles undergoing late stages of metamorphosis, metacercariae may occur either in the body cavity, in the tail stem, or in the developing hind legs. In adult frogs, diplostomula are limited to the muscles of the hind legs, usually within tissue capsules produced by the host. Rate of development of diplostomula is closely related to the stage of metamorphoses of the second intermediate host at the time of cercarial penetration. Length of time required for metacercariae to become infective is variable. Experimental evidence indicates that most of them require 30 to 35 days. Garter snakes of the genus *Thamnophis* may serve as transfer or paratenic hosts in the life cycle but are not necessary for its completion.

When encapsulated metacercariae are fed to white mice, young adult flukes may be found firmly attached to the villi of the duodenum of these hosts within three hours post-feeding. Hind-body and reproductive elements develop rapidly and individuals containing intra-uterine eggs may be recovered from the host's intestine six and one-half days post-feeding.

Careful comparative studies of the adults of the three American species of *Fibricola* (*F. lucida*, *F. cratera* and *F. texensis*) indicate that *lucida* differs significantly from the others. Despite numerous similarities between the adults of *cratera* and *texensis*, significant difference in their cercarial and metacercarial stages warrant their retention as separate and distinct species.

Microfilm \$2.00; Xerox \$4.60. 87 pages.

A STUDY OF THE FAUNA OF OYSTER BEDS WITH  
SPECIAL REFERENCE TO THE SALINITY FACTOR

(L. C. Card No. Mic 58-2746)

Harry Wilson Wells, Ph.D.  
Duke University, 1958

Supervisor: I. E. Gray

To test the hypothesis that salinity is the most important factor limiting the upstream distribution of oyster associates, the fauna of oyster beds near Beaufort, N. C., was studied with special attention to distribution limits and salinity. Oyster associates and supporting hydrographic data were collected at a series of stations in Newport River. A total of 296 species were collected. The occurrence of these species was classified as to seasonal and salinity distribution. The average number of species per collection ranged from 67.0 at the most seaward station to 16.3 at the most brackish station. Similarly, the total number for each station was found to decrease in proportion to lower salinities.

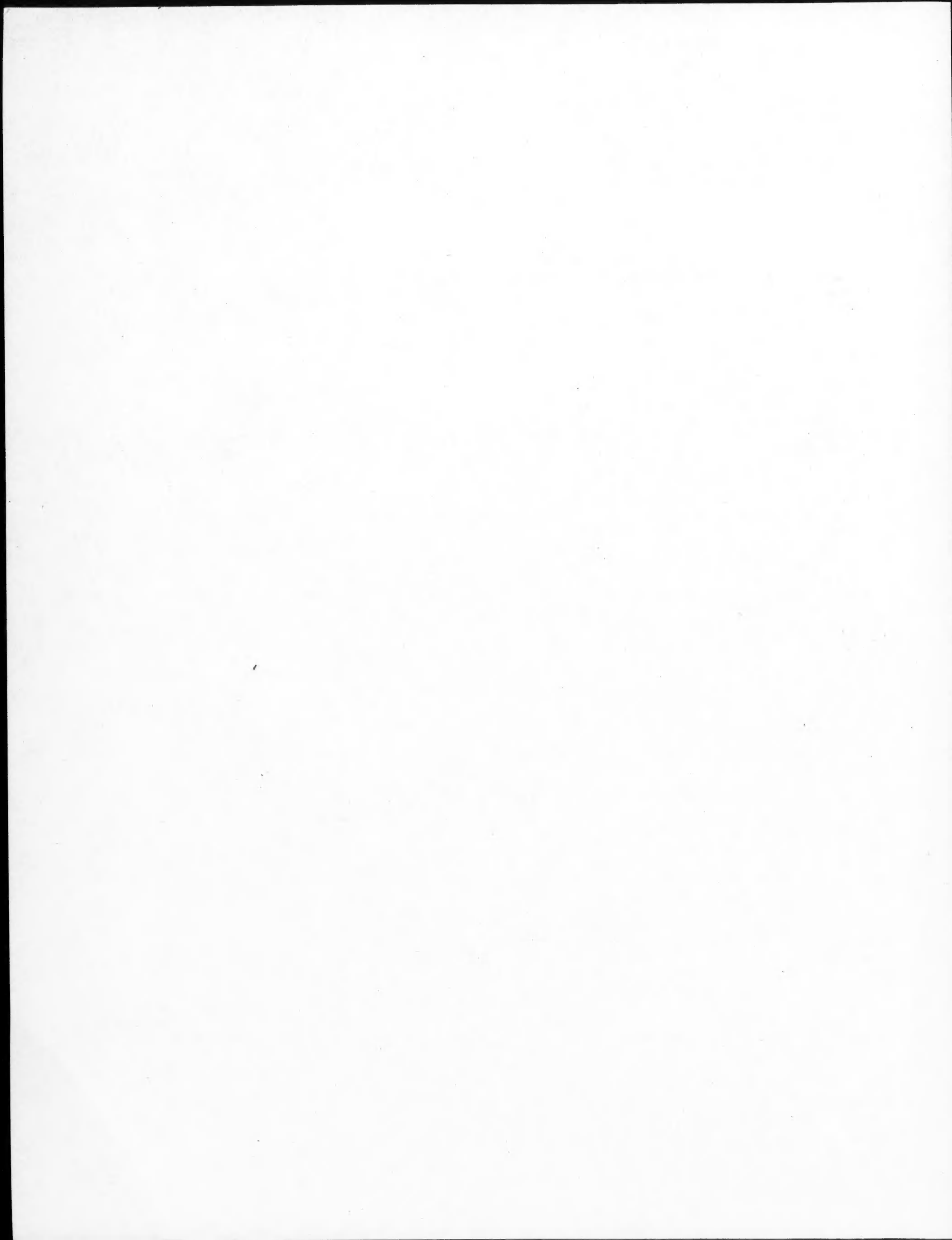
The effects of hurricanes Connie, Diane, and Ione on the oyster beds were followed in 1955, when very low salinities produced mortalities among oysters and many associated organisms. Repopulation of beds by certain species was delayed until reproductive periods the following summer.

Salinity tolerance of twenty species was tested in the laboratory, by placing animals directly into dilutions of seawater. Salinity death points were thus obtained. Ranked in order of their tolerance to reduced salinity, the animals tested were *Mercenaria mercenaria*, *Panopeus herbsti*, *Eurypanopeus depressus*, *Modiolus demissus*, *Clibanarius vittatus*, *Crassostrea virginica*, *Nassarius vibex*, *Pagurus longicarpus*, *Thais haemastoma floridana*, *Odostomia impressa*, *Urosalpinx cinerea*, *Busyon carica*, *Brachidontes exustus*, *Fasciolaria hunteria*, *Asterias forbesi*, *Cantharus tinctus*, *Chione cancellata*, *Arbacia punctulata*, *Cerithium floridanum*, and *Lytechinus variegatus*.

With the exception of *Thais* and *Clibanarius*, which could stand lower salinities than those of their normal environment, the salinity death points correlated very definitely with distribution limits in Newport River.

Applying this evaluation to the animals of the oyster bed community, the majority of species were found to be directly limited in their upstream distribution by salinity. Where tropical storms may cause freshets during high temperature periods, their occurrence may produce an effective limitation to upstream penetration for many estuarine animals.

Microfilm \$2.00; Xerox \$5.60. 114 pages.



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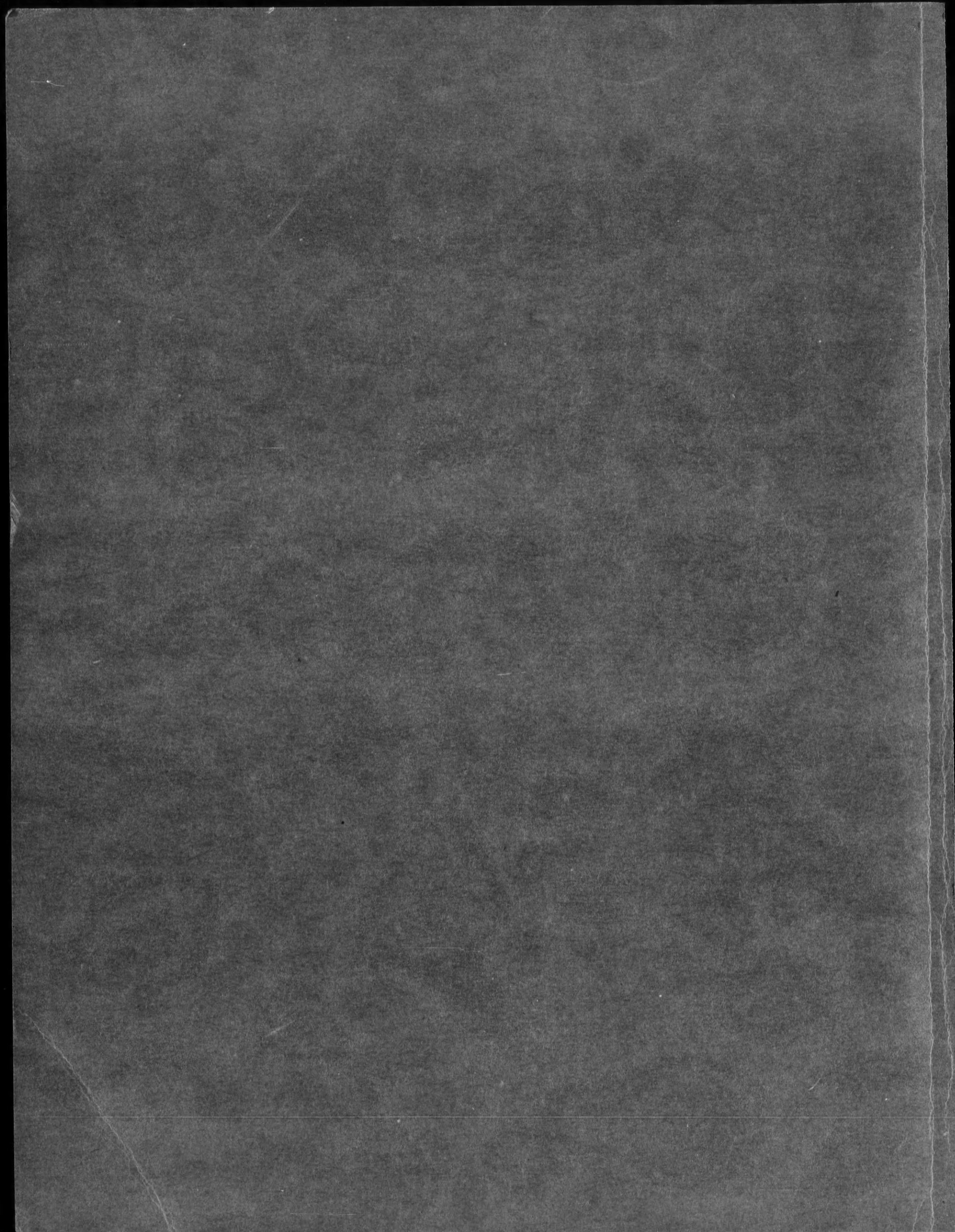
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